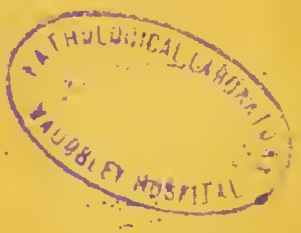
PROS AND CONS OF VIVISECTION

CHARLES RICHET

Dr. F. W. Mott

With kindest regards
from W.O.H.

Dec. 1908.



THE PROS AND CONS OF VIVISECTION

"LA MORT."

By Bartholomé in Père Lachaise, Paris.

Frontispiece.

THE PROS AND CONS OF VIVISECTION

BY

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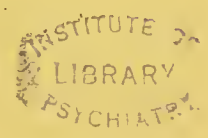

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PREFACE

To scientific readers, Professor Charles Richet needs no introduction, but to the public at large it may be necessary to mention that he is one of the best known of French physiologists. He has occupied for a good many years the Chair of Physiology in the Faculty of Medicine in Paris, and he has contributed greatly to the progress of the science to which he has devoted his life; some of his discoveries are alluded to with all modesty in the pages which follow. He is, moreover, a man of great erudition, and has been wisely selected to be the editor of a monumental work, *Le dictionnaire de physiologie*, which is issuing from the press to-day.

Professor Richet has given particular attention to the study of the psychological side of physiology, and his views on pain will be read as coming from one who is specially fitted to deal with this and other mental phenomena.

I therefore consider it a great honour that

Professor Richet should have asked me to write a preface to his most interesting and convincing book on the Pros and Cons of Vivisection, and it is a great pleasure to me to commend its thoughtful perusal to all who are interested in the subject.

Professor Richet is not only one who speaks with authority, but he is one of the gentlest and kindliest of men. The science which he teaches is the science of life. To understand the meaning of vital processes it is necessary to study the living organism, and to obtain this knowledge it is sometimes necessary to perform experiments on living animals. When he defends a practice which many regard as cruel, detestable, and immoral, mainly because of the unscrupulous misrepresentations put forward by the professional Anti-vivisectionists, he does so because he is convinced that none of the epithets just mentioned correctly describe the experiments which are carried out in physiological laboratories at the present time. These experiments are undertaken only by properly qualified persons having a due sense of their responsibilities. Every regard is paid to the comfort of the

animals employed ; and the ultimate aim of this work is the progress of knowledge, and the consequent relief to suffering which is so often only the result of ignorance. The benefits which accrue are felt not only by human beings, but also (as in veterinary practice) by the animals themselves. No attempt is made here to defend experiments which have not these objects in view, or which (as has happened in the past) pay no consideration to the pain an animal experiences.

I feel quite sure that if the British public were convinced that the experiments in our laboratories were all conducted in accordance with our present law, the Anti-vivisection crusade would flicker out. It is the object of those who are active propagandists on the other side to keep their agitation going, by omitting to mention the painlessness of the operations performed, or by suggesting (either directly or by innuendo) that anæsthesia is a sham. My own experience, which is a wide one, has been that physiologists not only obey the law literally, but are most punctilious in its due observance. A certain number of trivial irregularities have been reported to the Home

Office by the inspectors appointed under the Vivisection Act, but there has been no case of omitting the use of anæsthetics. The majority of these offences have been for using anæsthetics unnecessarily. A certificate in certain cases is granted for the omission of an anæsthetic : this is given when the operation is a trifling one, and has never been granted for any operation more serious than the prick of a hypodermic needle. Nevertheless, the operator has sometimes employed an anæsthetic even for this, and has in consequence been reported to the Home Office for infringing the terms of his certificate.

Pawloff has truly said that the ideal experiment is one performed without anæsthesia and without pain. In many cases this ideal can be realised, but in other cases it is unattainable. Physiologists have, therefore, had to select which of the two disturbing factors shall be absent, and they have unhesitatingly chosen the latter. Pain must be absent (1) on grounds of humanity, (2) because it is a far greater disturber of the normal functions than anæsthesia is, and (3) because the struggles of an animal in pain will nullify the accuracy of the experiment, and

endanger the safety of the delicate apparatus which it may be necessary to employ.

Exactly the same arguments apply to the employment of the antiseptic or aseptic methods of surgery, in experiments in which the animal is kept alive after an operation to study its effects. The healing process is then painless, and there is absence of those febrile and inflammatory conditions which would otherwise complicate the issue.

It is therefore for two reasons that an experimenter uses both anæsthetics and antiseptics, (1) to save the animal suffering, and (2) to ensure the success of the experiment.

The barbarities which are recorded by Anti-vivisectionist agitators do not exist; the repetition of their stories in spite of repeated contradictions is partly due to wilful misrepresentation and exaggeration, and partly the result of ignorance of the meaning of the technical terms employed by physiological writers.

At the Royal Commission which is now considering the question of Vivisection, the cases of alleged cruelty have been one by one sifted to the bottom, and in no single case has a charge

of cruelty been sustained. Any one who cares to wade through the four bluebooks of evidence which have been printed will discover for himself that this is so. In fact, one prominent Anti-vivisection journal (the *Verulam Review*, April-June 1907, p. 186), in reference to the evidence given by one of the witnesses before the Commission, had to confess, "Almost every one of Mrs Cook's horrifying cases seems, when examined, to melt away."

An Anti-vivisectionist publication which has obtained some notoriety ("The Shambles of Science") figured in a recent lawsuit. When the particular charge which was the subject of the action was investigated by a prolonged inquiry before the Lord Chief-Justice, a British jury showed their sense of the enormity of the slander by awarding the physiologist impugned the very substantial damages of £2000. An undertaking was subsequently given by the publisher of this "hysterical work" (to quote the words of the Lord Chief-Justice) that it should be withdrawn from publication. Yet the book has been since re-issued by the authors, with the chapter that formed the subject of the trial omitted, but other-

wise with very little alteration. The libellous statements scattered through its other chapters can still be read by the lovers of sensation, and the authors doubtless hope that their readers will never take the trouble to read also the evidence before the Royal Commission in which all the allegations of cruelty have been shown to be groundless.

The subject of curare, another bugbear of the Anti-vivisection lecturer, is so adequately dealt with by Professor Richet that I will spare the reader any further discussion on that question here. I have taken the liberty of adding, in a footnote on p. 36, a statement in respect to the usages of English physiologists in relation to that drug.

The experiments of the pharmacologist in the investigation of the action of drugs can be and are carried out under anæsthesia in the same way as those of the physiologist. But the experiments of the pathologist, which consist in conveying germs and other disease products to animals, come under a different heading. One does not deny that if the animal takes the disease, suffering is produced. This is fully admitted by Professor Richet, and I think that

any common-sense reader will be convinced by the arguments put forward that the practice is fully justifiable. It is difficult, as Professor Richet points out, to gauge the amount of pain an animal such as a rat, guinea-pig, or rabbit (the animals usually employed for the purpose) really feels when given a disease experimentally, and whether this is greater or less than the suffering it will endure when another disease or a violent death carries it off in the usual course of nature. It is, however, undeniable that the suffering of these animals is much less than those of human beings. A man, when he is ill, suffers a certain amount of discomfort and physical bodily pain; but this is a drop in the ocean compared to the mental worry and anxiety he endures—all that, at any rate, is absent from the suffering rabbit. The pathologist sees beyond the pain which he inflicts to the pain which he prevents. The death of a few lower animals may be, and has in the past been the means of preventing pain and disease both to the animals themselves and to human beings also, who may be counted by thousands or even millions.

If there is one piece of evidence more than

another which was given before the Royal Commission that deserves rescue from the oblivion of a bluebook, it is that given by Lord Justice Fletcher Moulton. His is one of the keenest legal intellects of modern times, and he at any rate cannot be accused of having any axe of his own to grind. I regret that exigencies of space prevent me from making more than one or two references to it.

He begins by taking the case of a ship infected with plague, and infested also with rats, the carriers of plague. The ship enters port. Would it be preferable to kill the rats, and so prevent them and the disease from entering the port and causing untold disaster there, or staying one's hand because the slaughter of the rats would be a painful proceeding? The captain who gives orders for the destruction of the rats inflicts pain and death on them in order to prevent greater pain and more widespread death elsewhere. The captain who says, "Spare the rats," is guilty of the criminal act of causing the death of many innocent human beings. So it is with the Anti-vivisectionists: they see only the pain inflicted, and do not heed the pain prevented.

On this score they are in a sense logical when they call Lord Lister a brute, although he of all men living at the present time has been the means of preventing the greatest amount of suffering. They see only the pain which he deliberately inflicted on a few rats and rabbits; they cannot see, or refuse to see the measureless amount of misery he has prevented.

In another place the Lord Justice points out that the pain inflicted in all the laboratories of the country put together during a year is infinitesimal compared to that which is inflicted every day in the slaughter of animals for food; to that which ignorant farm labourers inflict without anæsthetics, in spaying animals by thousands in order that beef and mutton may be tenderer or have a more pleasant flavour to the consumer; to that inflicted by sportsmen when their victims, imperfectly shot, die a lingering death; to that which women thoughtlessly allow in order that they may have ospreys in their hats and furs upon their backs.

So far as the satisfaction of appetite, the pandering to the so-called sportsman's instincts, or the gratification of vanity are concerned, these

things may go on. The average Anti-vivisectionist disregards them, or at least makes no effort to prevent them. The only kind of pain which stirs his feelings, and meets with his opprobrium, and enables him to indulge in his favourite epithets, is *the one justifiable bit of pain in the whole world*—a pain inflicted with the noblest of all objects, and by the most humane of all men (for so the medical profession admittedly is), the object, namely, of preventing future pain, which otherwise would encompass the world of life.

Professor Richet has wisely not made his book too long. He has been content to select a few typical and striking examples of the benefits which experimentation on animals has conferred upon humanity, instead of attempting even to enumerate them all. He might for instance have dwelt upon the extinction of rinderpest in South Africa: here, at the expense of a few experimental animals, Koch has prevented a scourge which formerly exterminated hundreds of thousands of cattle annually, and might still be exercising this fell influence on to all eternity if the opponents of scientific knowledge had their

way. He might have taken the case of snake bite, and the discovery made by his great fellow-countryman Calmette of the means of combating this deadly poison, which has hitherto killed our Indian fellow-subjects by its tens of thousands a year.

On coming to one of the most recent of beneficent discoveries, he might have dwelt upon the case of Mediterranean fever, and the way which it has been practically stamped out at Malta and Gibraltar, because the method of its spread has been discovered and the disease prevented at the expense of a few goats and other animals.

But those who are wilfully deaf to such arguments will not, I fear, be convinced, even if examples are multiplied indefinitely. In spite of the love for animals which our opponents profess, the life of cattle, particularly if they are so far away as South Africa, does not appeal to them. The happiness of the teeming millions of India does not come home to them. Even the comfort of our brave soldiers and sailors in the Mediterranean stations is of little account: they have never visited the hospitals at Malta or

Gibraltar, and seen, as they could have seen a year or two ago, the poor fellows dying off like flies from a mysterious disease that nothing could be done for, because the manner in which the fatal germ entered their bodies was unknown. Now, by the simple prohibition of the use of goat's milk, a prohibition due to animal experimentation and to that alone, the disease has been exterminated.

Anti-vivisectionists do not come in contact with disease all day and every day as medical men do; they therefore do not realise how widespread it is, and what terrible forms it may take. Their notions are vague; they talk about suffering without any intimate knowledge of the question. They bestow their sympathies upon the few victims of the vivisector's knife or syringe; they have none left for the larger number of victims which would have suffered if the few had not been sacrificed. Can it be wondered at that medical men, whose experience is so different to theirs, feel otherwise? The doctor's life is not one in which these are just a few painful partings with dear ones, but he is steeped in such experiences from morning till

night. His sympathies aim at the relief and cure of all this evil; and the death of a few guinea-pigs or rabbits is a necessary incident which he has the courage to permit because of the greater good that is the ultimate result.

There are, however, some of the examples which ought to stir better feelings even in the Anti-vivisectionist camp, namely, cases of diseases which are common or used to be common in our very midst, and which we need not go to India or Malta to look for. One of these is diphtheria, and the statements and statistics in relation to the almost miraculous change which has come over our ideas on this affection are incontrovertible, and are fully set forth in the following pages. The disease no longer inspires the terror it used to do, for it is one which can be cured, and easily cured, by the method of serum therapy. It has not, it is true, been stamped out, for up till the present success has not attended efforts of prevention. Prevention is better than cure, but cure is better than suffering and death. Just now, medical science can cure the disease, and if medical progress continues at its present rapid rate of growth, who can doubt that in

the near future this disease, like typhus and typhoid, will be stamped out?

Typhoid fever is an example of a disease which has only died out in this country quite recently. When I was a student the hospital wards were full of it; but to-day most medical students in London pass through their entire curriculum of five years or more without ever seeing a case. What has been accomplished for London can also be carried out in other large cities, and the extinction of the disease is entirely due to improved sanitary measures, and the destruction of the bacillus which causes the malady. We often quite legitimately complain of the extravagances of our Government departments and our County Councils, and of their apathy in questions affecting the health of the country. We are still awaiting, for instance, proper legislative measures to ensure the purity of milk. But this at least we can thank them for—proper methods of disinfection and a purer water-supply have led to the almost complete extinction of what was a common and painful and fatal disease. But how does Vivisection come in here? County councillors are not Vivisectors. No, they are not,

white corpuscles are 'below par,' that catch the disease. In assisting the white corpuscles to perform this important function, the co-operation of certain substances dissolved in the fluid portion of the blood is also necessary. The most recently discovered of these auxiliary substances are called *opsonins*. The word opsonin is derived from a Greek root which means "to prepare the feast." The opsonin either adds something to the bacterium which makes it tasty to the white corpuscle, or removes (or neutralises) something which previously made it distasteful. White corpuscles will not as a rule ingest and devour bacteria from a pure culture, but they do so eagerly immediately the bacteria are bathed in serum ; and the serum which is most efficacious in acting as a sort of sauce is that which has been obtained from an animal which has been previously infected with the same kind of bacteria, and which has recovered from the ailment such bacteria have set up.

This is not mere fancy : the whole sequence of events can be easily followed on a glass slide kept at body temperature and examined with a microscope.

It is well known that if the yeast plant (which is very similar in many details to bacteria) is grown in a solution of sugar, the sugar is broken up and disappears, and two new substances formed from the sugar take its place. These are alcohol and carbonic acid gas. If bacteria grow in the blood, they do not produce alcohol, but they do produce other poisons in a way analogous to that by which yeast produces alcohol. These poisons are called *toxins*. There are substances in the fluid part of the blood which are called anti-toxins, because they neutralise the toxins produced by the bacteria. Their presence constitutes a means of defence against the harmful effects the toxins would otherwise produce. The marvellous part of the defence is that, although we all have a certain amount of anti-toxin in our blood, the amount increases in proportion to the amount of toxin. It is a familiar fact that rough manual labour increases the hardness of the hands; friction stimulates the epidermis or outer skin, so that it grows in thickness. The body affords numerous similar instances of how it is capable of rising to the occasion and increasing its defences.

Just in the same way, the presence of a toxin stimulates the living cells to produce more and more anti-toxin, and the blood remains rich in the anti-toxin for a considerable time afterwards. This explains why a person who has had an infectious disease does not take it readily a second time; he is immune for a certain number of years, because his blood is so rich in the antidote.

Now, the principle of serum treatment depends on those ascertained and definitely proved facts. In the modern treatment of tuberculosis, for example, the aim of the physician is to increase nature's method of cure: good food and pure air do much to increase the healthiness of the blood and fortify its natural power of destroying the germs; sometimes this alone suffices. At other times it is not sufficient, particularly if the disease has advanced and the number of bacteria is too great for the enfeebled white corpuscles to deal with. Then the physician goes a step farther, and administers the appropriate opsonin by injecting it under the skin, again simply increasing the resistance of his patient by a perfectly natural method.

In the case of diphtheria, the antitoxin appears to be more efficacious than an opsonin. A horse is inoculated with diphtheria, and when he has recovered, his blood is collected. This blood is then rich in antitoxin, the natural antidote that has enabled the horse to get well again. The blood is allowed to clot, and the clot is removed; the fluid residue is called serum, and the serum contains the antidote. If now another horse has diphtheria, and you want to cure him quickly, what more natural than inject the serum of the horse who has just recovered? it will save the second horse the trouble and the time of making the antitoxin for himself, and it has been proved over and over again that the second horse does recover with amazing celerity.

The pathologists then advanced a step, and asked, Why should this antidote be used solely for animals when they have diphtheria? Why should not the horse's serum be beneficial to human beings when they are attacked with the same disease? The diphtheria poison is much more harmful to a man, and kills him more quickly than it does a horse; it is therefore imperative to use the antidote early. The crucial

experiment was made; entire success followed it, and now, as Professor Richet says, it is the only treatment employed, and any medical man who refuses to use it is little short of a criminal.

I have entered into this brief and, I trust, simple explanation of serum treatment, because so many people want to understand it and are unable to comprehend the technical terms which scientific men, writing for scientific readers, almost exclusively employ. I am even hopeful that some of the more reasonable opponents of animal experimentation may be convinced that by carrying out the new methods of serum therapy, we are not going against nature but helping her. It is just these 'messy things' that nature uses for curing infectious diseases, and the introduction of an opsonin or an anti-toxin is not putting matter in its wrong place, but in its right place; and therefore the use of the terms filth and dirt in this relationship should be confined either to the foul-mouthed or to the ignorant.

W. D. Halliburton.

July 1908.

P.S.—The proof sheets of Professor Richet's book have passed through my hands during their issue from the press. Beyond a few verbal amendments, and a footnote here and there which I have added and initialled, no alterations have been made in the original.

I am also responsible for the insertion of Appendix C, regarding the aims and objects of the Research Defence Society. These additions and minor alterations have all met with Professor Richet's approval.

I may mention that the book has not yet been published in French, and is presented to the public for the first time in English dress. The English lady who collaborated with Professor Richet in its production has worked with and studied under him for some years, and it was largely owing to her persuasion that he consented to express his views publicly. She desires for the present to remain anonymous.

W. D. H.

October 1908.

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INTRODUCTION

THE object of this book is to set forth, as impartially as possible, the reasons which militate for and against vivisection. It is, however, a physiologist who is speaking, therefore no one will be surprised that he should defend a practice which is at the basis of the science he teaches.

May he be permitted, at the same time, to express the high moral esteem which he feels for all those who, nobly enamoured of a very high ideal, deny to men the right of inflicting suffering, or even death, upon animals? There is not a more generous thought than this. Without doubt it is our duty to have sympathy for, and to abstain from indifference and cruelty in our dealings with all living creatures: might does not constitute right. Man is stronger than the animal; but this superiority of power, this might, does not constitute a right to act contrary to moral obligation.

Morality does not consist solely of duties towards human beings; it is more general: it extends to every being capable of suffering. The physiologist is not an ignoramus, neither is he a barbarian; and he has right well understood this duty. Physiologists have concluded that experimentation upon living animals is necessary, and it is the many reasons which have led them to this opinion which I propose to set forth. But it will, I hope, be quite understood that my defence of vivisection implies no contempt, no raillery, no unfriendly sentiment towards those who oppose it. My opponents are not always courteous or loyal in their polemics; but that is of no importance; and I shall reply only to such objections as are potent, able, and rational. In other words, I shall take from among the arguments of anti-vivisectionists those only which can be called legitimate, those which deserve to be studied methodically and profoundly by every man of good faith. I shall deliberately put on one side both abuse and nonsense.

I should here mention an anonymous leaflet which has received a considerable amount of publicity in England ("How Scientific Cruelty is

defended," London, 1907, 4 pp.). In this leaflet, a reply is given to an article which I once published on Vivisection. Certainly, after a lapse of twenty-six years, I might claim the right to abjure some of the notions of my youth. Taken as a whole, however, my ideas concerning vivisection have changed but little, and I still consider it to be necessary. I of course recognise that the number of physiological laboratories, which I estimated at thirty in my article, is for present-day purposes too low. During the last twenty-six years their number has very considerably increased. But a laboratory of physiology does not necessarily mean a laboratory of vivisection. There is the whole range of physiological chemistry, the study of ferments and psychological physiology, not one of which makes any demands on vivisection. Many eminent physiologists—for example, my former master, M. Marey—have performed very little vivisection. Even in those laboratories where vivisection is performed, it is not practised every day, and especially not upon dogs! Far from it! In Paris, for example, where every dog experimented upon is a stray animal handed over

by the prefecture of police, there are only about six hundred dogs per annum thus available for experimentation. Now the laboratories in Paris represent, from the point of view of activity, at least half of all the laboratories in France put together.

It is alleged that Schiff stated to Mrs Anna Kingsford that he had experimented on more than 14,000 dogs, that is to say, an average of one dog a day for fifty years! This is obviously an exaggeration, though it is difficult to trace now who was responsible for it.

Finally, the remaining objections of the anonymous author in question amount only to this: The author believes that physiologists work for money and renown, and not at all for the sake of humanity (! !). Also, that young men are made cruel by the sight of cruel experiments. But the author simply forgets this fact, that there is not at this present moment one single *honourable* physiologist who would consent to perform long and distressing experiments on an animal not under anæsthetics. I hold no brief for those who do otherwise, and I disapprove energetically of the use of *curare*. The con-

clusions of my anonymous critic therefore fall to the ground.

I confess I do not understand the statement that experimentation on rabbits and other animals is of no use to humanity; and my critic unfortunately from his point of view has selected Claude Bernard's experiments as an example of uselessness. Does he not know that Claude Bernard discovered the presence of sugar in the blood, of glycogen in the liver, of diabetes produced through nervous action, of the action of oxygen and of carbonic oxide on the red blood corpuscles, the action of the pancreatic juice on fat, the part played by the pneumogastric nerve in the innervation of the heart? These discoveries not only rejuvenated physiology, but exercise a permanent influence over the whole of medicine, and over the entire realm of therapeutics! I refuse to accept the antiquated conception of an empirical medicine which does not aim at discovering the truth; which thinks solely of clumsy practical application; and which regards as useful only that which leads immediately and directly to the cure of a given illness. All truth is useful; all ignorance is baneful; and the sole

limit to man's power lies in the extent of his knowledge. We must forego discussion with those who cannot understand this fundamental notion.

CHAPTER I

THE NECESSARY LIMITS OF VIVISECTION

First of all I declare, without fear of being contradicted by any physiologist, that the past has witnessed much excess, almost guilty excess, and that at the present time excess might still be pointed out. I quite believe that, even to-day, here and there in the laboratories of physiology, young men may be found who are no doubt enamoured of science, but who have not sufficiently reflected on the nature of pain, and consequently, through lack of sympathy, are callous and indifferent about inflicting useless, or almost useless, tortures on innocent animals. On this point I might mention numerous facts which are extremely painful to relate, but which nevertheless we must have the courage to acknowledge and denounce.

To quote only one instance, a most abominable one, I will mention the following, which is old,

dating back about forty years. In the veterinary schools, surgical studies, at that time, were not made on the dead carcase, but on the living animal; so that the wretched victim, generally a horse, served as a subject, while yet alive, for all the operations which the veterinary surgeon is called upon to perform. The detestable argument given at that time to qualify this barbarism was that the veterinary surgeon should be familiar with the reactions of a living animal, and that, as a guarantee of being able to perform an operation on a diseased horse, he should have already practised the same operation several times, not on the dead body, but on a horse full of life and vigour, able to defend himself, and obliged therefore to be held down motionless by special processes. But this is scarcely a sufficient justification. But happily such things no longer exist; public opinion, stimulated no doubt by the writings of anti-vivisectionists, has altered the customs of veterinary experimentalists so well that in no veterinary school to-day are surgical exercises now performed on other than the dead body.

Thus, as far as surgery is concerned, unques-

tionably all vivisection should rigorously be proscribed. I will discuss later the point as to whether this interdiction should be moral—that is, recommended as a precept of humanity, or enforced by law under penalty of imprisonment or fine. For the moment it will suffice to establish the point that no living animal should serve for surgical exercises.

I will go even further, and on this point my opinion will perhaps clash with that of some of my friends and colleagues: I maintain that no experimental physiological demonstrations which involve suffering should ever be performed. Much abuse has taken place in experimentation for instruction, which is a very different thing from experimentation for investigation. Important as it may be to demonstrate physiological facts to students, I do not consider that this importance is greater than the suffering of an animal. And here again I will take an example, that of the distinction between the motor nerves and the sensory nerves.

Magendie, in 1811, following up an idea somewhat hesitatingly put forth by Charles Bell a few years previously, demonstrated that the

anterior nerve roots, starting from the spinal cord, give movement to the muscles, whilst the posterior roots are exclusively devoted to sensibility; so that there are anterior motor nerves and posterior sensory nerves. In order to demonstrate this, it is evidently necessary to operate on a living and sensitive animal.

The discovery was confirmed by several physiologists between 1830 and 1850; and I do not think we have the right to repeat this cruel experiment for the sake of the instruction of students. It is not only cruel, but also useless, for it consists in laying bare the anterior and posterior nerve-fibres of the spinal cord, with the sole object of allowing students to see that the excitation of the anterior nerve-fibres provokes movement and not pain, whilst the excitation of posterior nerve-fibres provokes pain and not movement. Now, in order to make students clearly understand this distinction between the motor and sensory nerves, I require only a blackboard and a piece of chalk; and I claim that, with a piece of chalk and a blackboard, I am able to explain very clearly all the details of this phenomenon. Not only does the chalk

suffice for comprehension as well as vivisection, but it is better; because the experiment is so delicate, so difficult, and, in order to be understood, it must be observed so narrowly, so closely, that out of the whole class scarcely two or three students are able to follow the experiment. The rest of the class have before them only the frightful spectacle of the reactions of a mutilated, suffering animal under excitations which are made in the very depths of a wound on organs which they do not see.

This experiment is rendered more particularly cruel by the fact that anæsthetics cannot be used, precisely because the point in question is the sensibility or non-sensibility of the animal, and consequently by its very nature the operation cannot be made on the insensible animal.[1]

And now, at once entering further into the difficulty of the problem of vivisection, we may ask ourselves if we have the right to allow demonstrations of experimental physiology on

[1] The usages in English laboratories in relation to this experiment are in accord with Professor Richet's views.—(W. D. H.)

living animals that have been rendered insensible by chloroform.

Although, further on, I intend coming back to this important question of anæsthetics, I will say at once I do not understand what repugnance there can be to operating upon an anæsthetised animal. Once he is insensible he cannot suffer; why hesitate, therefore, to perform prolonged experiments upon that insensible being? It appears to me just as inhuman to boil milk as to excite the pneumogastric nerve of a dog rendered incapable of suffering. The milk does not suffer; the dog does not suffer; in both cases it is living matter, but insensible living matter. Consequently, as far as physiological demonstrations are concerned, every individual capable of reflection should recognise that there is nothing wrong in experimenting upon animals that cannot suffer.

I shall, however, make two restrictions. The first is that professors should energetically call the attention of the pupils to the fact that the animal is insensible, and that no one has the right to make the experiment upon a sensitive animal; that we, physiologists, more than all

other men, are under the obligation of dealing humanely with animals. The professor of physiology should take advantage of the occasion to develop in his hearers the best and noblest sentiments, those of pity and of generosity. In a word, he should excuse himself, so to speak, for performing vivisection, and prove that such is only legitimate when it entails no suffering.

The second restriction is that the animal thus chloroformed or anæsthetised should never be permitted to awaken. If he shows the slightest sign of sensibility, he should be given chloroform until anæsthesia is complete, and, finally, he ought to be killed after the experiment, without allowing him to regain consciousness.

After all, death under these conditions is a painless end. We ourselves, who will disappear after a long, and certainly painful, agony, in those weary moments of pain which will precede our end, shall envy that absence of suffering, that rapid end of all pain, which is the death of an animal under an anæsthetic.

Let us, therefore, banish every painful experiment the object of which is purely didactic. Moreover, I fail to see what experiments in

painful vivisection are necessary for the teaching of physiology. Studies on reflex movement can be made perfectly well on a decapitated animal; and in that case it is well understood that there can be no question of pain; for it would be absurd to suppose that the spinal cord possesses the power of receiving the notion of pain. Such a supposition would mean the negation of the best-established facts of physiology.

Experiments on the heart (notably of the frog and the tortoise) are performed very much better on a decapitated animal than on an animal which is intact; and experiments can even be made on the heart separated from the organism. It would be downright puerile to lack the courage to watch the beating of the living heart of a dead tortoise! As for the mammalia, all experiments on the heart and on the respiration necessary in a course of lectures on physiology are admirably carried out on an animal rendered completely insensible.[1]

[1] It may not be known to many readers, that it is possible to keep alive for hours and even days the heart entirely removed from the body of a dead mammal. On such a heart the action of drugs can be admirably studied and demon-

We have not, however, quite finished with the difficulties of physiological instruction: there are certain poisons for which chloroform cannot be used.

As the essential property of chloroform is to deaden the nervous cells, the effects of some poisons cannot be studied in an animal profoundly chloroformed. We can watch very well indeed the effects of carbonic oxide, which poisons the blood, but many other poisons no longer produce their characteristic symptoms; nevertheless, it is of the highest importance to show medical students the effects of certain formidable toxic substances.

Permit me to quote myself. However little I may be a partisan of painful experimental demonstrations, I make one exception for an experiment which I consider it essential to present, in all its horror, before the young men who attend my lectures. I refer to absinthe. If two or three drops of essence of absinthe are injected

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strated. I once had in my own laboratory a rabbit's heart that continued to beat for nearly five days after the remainder of the rabbit had served for the dinner of my laboratory attendant.—(W. D. H.)

into the veins of a dog, he is at once seized by a violent attack of epilepsy with hallucinations, convulsions, and foaming at the mouth. It is truly a terrible sight, one which fills with disgust and horror all who have witnessed this experiment. But it is precisely for the sake of arousing this disgust, this horror, that I perform the experiment. The unfortunate dog will, durduring ten minutes, have had an attack of intoxication and absinthian epilepsy; but at the end of an hour he will have recovered completely. At the same time, the two hundred students who have witnessed this hideous spectacle will retain, profoundly engraved on their minds, the memory of that epileptic fury, a memory which will remain with them to the end of their days. They will then be able, by their propaganda against absinthe, to exercise around them a salutary influence, to prevent perhaps ten, fifteen, one hundred human personalities from destroying themselves by the use of this abominable poison. After all, it is better to give a dog ten minutes of absinthism than to allow twenty human families to be plunged, by absinthism, into degradation and misery.

Finally, as far as surgical exercises are concerned, *they should never be made on a living animal;* as regards demonstrations of experimental physiology intended for instruction, *they should be made only on decapitated or anæsthetised animals;* and as for intoxications,[1] save on very rare and altogether exceptional occasions, *they should not be made the object of experimental demonstrations.*

It seems to me that these formal declarations might be accepted by every physiologist as well as by every anti-vivisectionist.

[1] The word intoxication here and elsewhere is used in its literal sense, viz., poisoning. It is not limited, as in popular parlance, to the poisonous effects of alcohol.—(W. D. H.)

CHAPTER II

PAIN AND DEATH

We have not yet touched at the root of the problem, for physiology is not mere demonstration. The real point at issue is the search for new truths. The demonstration of an acquired truth, however important this may be, must not be confused with the research for an unknown truth. Now, physiologists claim that they have not only the right—but that it is their duty—to inflict some suffering on animals, if by so doing they diminish human suffering. I am going to put this proposition to the test.

1. It is universally recognised, except perhaps by the Brahmans, that we have the right to kill dangerous or offensive animals. I do not believe there is a man foolish enough not to kill a mosquito which is stinging him. No one would hesitate to crush a viper which is on the point

of biting him, or the caterpillar which is eating the leaves of his fruit trees. If an invasion of locusts threatens our harvest, we have the right to stamp out these legions of enemies. To refuse man the right to defend himself against his animal foes is such a ridiculous proposition that it is useless even to attempt to combat it.

Not only have we the right to wage war against offensive animals, such as rats, mice, caterpillars, locusts, bugs, mosquitoes, serpents, wolves, tigers, hyænas, and all ferocious and mischievous animals, but we have also the right to kill such animals as are necessary for our nourishment. I am quite aware of the fact that certain religions proscribe the use of meat. I am also aware that an exclusively vegetable alimentation might be substituted for our customary mixed diet, which is both animal and vegetable. But, though a vegetable alimentation is possible, our western civilisation is bound up with the principle of a mixed diet in the ordinary conditions of life. If, indeed, alimentation should be exclusively vegetable, it would be useless to hunt, to fish, to rear poultry, to breed cattle for the market; and it would be necessary to con-

fine our nutriment exclusively to wheat, corn, maize, rice, herbs, and fruits. Undoubtedly man, thus nourished, could live, and indeed live very well; but vegetarianism would be such a radical reform in our customs that in an article bearing solely upon vivisection I cannot handle such a vast problem.

I recognise that those anti-vivisectionists who are at the same time strict vegetarians are consistent; they live entirely on fruit and vegetables, make no use of animal flesh, for they contest the right of man to kill an animal for his nourishment. It is difficult to reply to such vegetarian,[1] for, after all, animal alimentation is not indispensable to human life. But we must take things as they actually exist. The bulk of my readers and the majority of anti-vivisectionists are not vegetarians; and it is only an innocent pastime to build up new civilisations in the fantastic realms of Utopia.

[1] The true vegetarian is an extremely rare person. The usual so-called vegetarian ought more properly to be called a non-meat eater, for he does not scruple to consume milk (intended by nature for the calf) and milk products (cream, cheese, and butter) and eggs, nor to wear garments made of wool and leather.—(W. D. H.)

We are not, then, addressing ourselves to vegetarians, but to those anti-vivisectionists who feel no compunction in drinking broth or milk or eating the wing of a chicken, who do not shrink with horror from the sight of a cutlet, and who are capable of eating meat twice a day throughout the whole term of their existence. These people know full well that it was necessary to kill the animal which serves them for food: the ox was beaten to death; the sheep had its throat cut open; the pig was bled to death; the cod and the sardine were suffocated. I pass over the tortures which special preparations and elegant sports inflict on the animal for the mere savour of our meals: geese stuffed by force for months whilst nailed down to boards; pheasants, partridges, hares, slaughtered in the hunt; fish thrown into boats, gasping and finally dying after long, agonising struggles. All these and other tortures are inflicted by man on the animal in order to satisfy his pleasure and his appetite.

Perhaps these anti-vivisectionists have never visited a slaughter-house when the moment for killing the sheep has arrived. There, bound and

stretched out on an immense table, are to be seen five hundred unfortunate sheep, with their throats thrust forth. The butcher passes in front and, with a stroke of his knife, slashes open the neck and throat of the poor wretches ; the blood spouts out, convulsions rend the body, and only at the end of one minute or one and a half minutes does death supervene. This is death in all its savage horror inflicted by man on the animal. There are anti-vivisectionists who accept this. Therefore, they recognise implicitly man's right to kill animals, since they profit by such slaughter for their alimentation ; they add, however, that though man has a right to kill, he has no right to cause suffering. Is there no suffering in the slaughter-house ? Are anæsthetics ever dreamt of there ?

2. Now it is impossible to point out the boundary line which separates the being that suffers from the being that does not suffer ; and I defy any one to establish any line of demarcation whatsoever between a being capable of pain and a being incapable of pain.

Plants certainly do not suffer. Already, however, there are certain difficulties in the way of

determining the exact boundary line between the animal and the plant. When we expose an infusion of hay to the air, for instance, various microbes develop therein. A learned and minute analysis allows us to distinguish both bacteria and infusoria among the innumerable micro-organisms which swarm in the infusion. Now we know that bacteria are plants and infusoria are animals. If, therefore, all animal life were eliminated from experimentation, we should have no right to boil an infusion of hay, because we know that it contains infusoria which are animals.

These infusoria are so closely related to bacteria that they may be confused with the latter, as indeed has been the case up to the last few years. A number of inferior beings were formerly called zoophytes, that is to say, animal plants; and it is sheer nonsense to suppose that they are conscious of pain. Sponges, corals, sea-anemones, star-fishes, sea-urchins, possess a nervous system which is so little developed, and reactions which are so indistinct, that we can scarcely suppose they possess an intelligent consciousness, and, consequently, sensibility to

pain. Moreover, I do not see how their reactions would differ if they possessed the notion of pain. When we touch the tentacles of a star-fish, we notice, near the tentacles touched, a sort of agitation set up among the neighbouring tentacles, but this agitation does not extend to the tentacles of the others' arms; so that a general consciousness does not appear to exist, unless it be in a prodigiously rudimentary state, among inferior beings. In certain classes of the mollusca there is no head. Thus oysters and mussels, named on that account *acephala*, have in all probability no consciousness. I would have no scruple, therefore, either in eating living oysters, or in experimenting upon living oysters and mussels, since it seems to me evident that the notion of pain does not exist in them.

It is not the same thing with insects; it is here that the first signs of pain begin to appear. Nevertheless, we must be careful to avoid confusing pain with signs of pain. When we take a worm and cut it into three segments, each of these segments will struggle and writhe in a perfect frenzy. It would, therefore, be necessary to

admit that pain existed in each of these three segments—in other words, that each fragment possesses a central seat of pain, which is absurd; it is much more rational to suppose that the perturbed movements of the animal are the result of a strong nervous excitation, and that the injury is accompanied by defensive reflex movements but provokes no painful perception.

Among the superior animals however, and especially among the vertebrata, pain exists. There can be no doubt about this, although it is impossible to know exactly in what consists the consciousness of pain in an animal; the most profound obscurity still reigns, and will perhaps always reign, over their consciousness and sensations. It would be ridiculous to deny that a dog suffers when his paw is crushed. Certainly, I fully believe that all pain is much less clearly perceived by the dog than by man. But, after all, it is a phenomenon of the same order and identical, save in intensity.

Now pain, taken in its profoundest sense, consists of two essential elements: a shock to the conscious self, the *ego*, in the first place; and,

in the second place, the prolongation of the shock. If the self is not distinctly conscious, if it does not go so far as to assert itself by the separation of that self from the external world, we cannot say that pain is possible. The *ego* never asserts itself with so much force as under a very painful impression. So that among beings whose reactions are mechanical, automatic, governed by other forces than by the assertion of the self and a freely deliberate will, pain becomes so indistinct, so confused, that it probably does not exist in the strict psychological sense at all. The greatest philosopher of modern times, Descartes, imagined a system of machine-animals ; this idea has been turned into ridicule by the ignorant, but nevertheless we are almost forced to return to it when we dive to the bottom of reflex movements. Now, if we are able to admit that there is a vague consciousness of the selfhood among superior animals, such as the mammalia and birds, this consciousness, as far as concerns the inferior vertebrata, is most certainly extremely hazy, if, indeed, it exists at all. I have difficulty in conceiving that a frog is able to ponder over its *ego*, assert its existence

in presence of the external world, and say or think, I SUFFER. No being suffers unless he is able to think that he suffers, and meditate on his suffering. To suffer means to have consciousness; and as far as it is permissible for a man to picture to himself the sensations of a frog, I should say that the frog has no consciousness of suffering.

Even as regards the more highly developed vertebrata, such as birds, rabbits, and guinea-pigs, suffering is probably of a very obscure nature. It is not enough to say that an animal suffers because we see him animated by the contortions and reactions of defence. The new-born infant, which has neither intelligence nor memory nor consciousness, is probably incapable of real conscious suffering, nevertheless it screams and cries when it is hungry or when it is pricked. But these screams and tears do not suffice to allow us to affirm that the child is suffering real pain. It is a nervous excitation which is translated by the reactions of defence; it is not the conscious assertion of an *ego* which has been painfully perturbed.

Further, for pain to exist the impression must

be durable and not fugitive. The assertion of the *ego* is not enough. It must be prolonged. A pain, however intense we may suppose it to be, which traverses the organism for a second and which leaves no painful echo behind it, is no real pain. I will allow any one to inflict the most excruciating tortures on me if he can assure me that, at the end of one second, I shall have lost all recollection of the suffering and that no trace of the torture will remain. The extraction of a tooth lasts perhaps only half a second, but you remember it all your life. In any case, for several minutes the pain continues to be atrocious. Therefore we may certainly consider that pain is a phenomenon of memory. Pain is an empty word for every being that has no memory.

From these facts we may evolve the general conclusion that, under penalty of falling into vulgar anthromorphism, we cannot apply to the pain of animals the data which have been gathered on human pain.[1] With man, the developed

[1] In the little leaflet already referred to, quotation is made of a sentence from Professor Pritchard, which says that the various animals have a skin of different thickness, but that

intelligence and vivacious memory enable pain to acquire an extreme intensity. But with animals, in proportion as the intelligence lessens and the memory becomes more rudimentary, so does pain diminish, and, without having the right to be very affirmative, as we are in profound darkness concerning the consciousness of animals, it appears to me that, as we descend the scale of the animal kingdom, pain rapidily becomes very hazy, scarcely perceived, and as indistinct as the consciousness of the *ego*.

We have, therefore, the right to perform vivisection on beings which, because they possess no *selfhood*, do not suffer. Now, this absence of memory, consciousness, and intelligence extends assuredly over the whole of the vegetable kingdom, almost certainly over all the groups of the invertebrata, and also probably over all the inferior vertebrata.

Finally, there remain only the mammalia and birds which are capable of real pain. Although this pain may be obscure and indistinct, it is

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sensibility is the same among all, including man. It seems to me that Professor Pritchard has scarcely looked into the questions of general psychology.

certain; and we must take it into consideration or fall into barbarism; therefore we shall restrict the problem of vivisection to the vivisection of superior animals, who, alone, are capable of suffering.

CHAPTER III

CONCERNING ANÆSTHESIA IN VIVISECTION

A FEW words are first of all necessary to indicate precisely what anæsthesia is.

By definition, an anæsthetic is a substance which, without paralysing the activity of the heart and the respiration, abolishes sensibility. Indeed, whenever general sensibility is abolished, there is, at the same time, abolition of consciousness, of intelligence, and of memory. Another characteristic of an anæsthetic is that its action is of a transient nature. At the end of a certain time, it disappears ; and then intelligence, consciousness, and memory return gradually with sensibility.

It is well known that the admirable discovery of general anæsthesia, allowing operations to be performed on man without the accompaniment of pain, was due to chance. It was an American dentist, Horace Wells, and his colleague, Morton

(and others also perhaps), who discovered by chance that protoxide of nitrogen (commonly called laughing gas) has the power, when inhaled, of annulling all sensibility to pain for a certain length of time—sufficiently long for a surgical operation (1840). Then they discovered the effects of ether (1842). Since then, many other anæsthetics have been introduced, notably chloroform, prepared by Soubeiran in 1832, but the anæsthetic properties of which were only discovered in 1847 by Flourens and Simpson; so that physiologists and surgeons are now quite familiar with the mode of action of anæsthetics.

Anæsthetics, in appropriate doses, poison the nervous cells, which are the seat of intelligence and sensibility, but leave unimpaired the functions of the cardiac nervous system and of the nervous system governing the respiration. An individual under chloroform breathes regularly; his heart beats rhythmically, but all intelligence has disappeared; he has no longer any will or memory or reflex actions, and the most painful operations can be performed on him without provoking the smallest phenomenon of sensibility.

Further, we have no hesitation in asserting that the anæsthetised animal behaves like the anæsthetised man; that is to say, chloroform given to an animal abolishes all sensibility to pain. Vivisection, therefore, on an anæsthetised animal, does not provoke any pain. Physiologists are so convinced of this that, however humane they may be, they have no scruple in performing lengthy vivisections on an animal which is thoroughly anæsthetised.

If chloroform, for some reason or other, cannot be employed, many other anæsthetics, such as chloral and morphia, may be used. Chloral, in certain doses, produces complete anæsthesia, and it is easier to administer than chloroform. Formerly, chloral was injected, by a small puncture, into the veins of rabbits and dogs. I pointed out another method which allows one to avoid even the puncture; it is sufficient to make a rectal injection of the solution of chloral. In two or three minutes, the dog, the rabbit, or the guinea-pig, is seized with a kind of inebriety; he staggers, falls to the ground, and in about ten minutes he is completely anæsthetised. Large doses of morphia can be injected into

animals without causing immediate death. An animal under a moderate dose of morphia does not absolutely lose all sensibility to pain; but the slight pain which he then feels is very transient. If the animal is submitted to strong excitation, he wakens for a few seconds, but soon falls back again into profound slumber. Morphia in moderate doses is not such a perfect anæsthetic as chloral or chloroform; it is therefore usual under such circumstances to administer also volatile anæsthetics like chloroform, and quite small quantities of the latter will then produce perfect anæsthesia. If, however, morphia is given in lethal doses, as is sometimes done for comparatively short experiments, it is an absolutely complete anæsthetic in itself, just as it is when a man takes a fatal dose of morphia, or of its parent substance, opium.

Nevertheless, chloroform, chloral, and ether have a very serious disadvantage for the physiologist. They abolish sensibility, but, at the same time, they abolish the majority of the reflex actions in which voluntary muscles are concerned. Now, in many experiments, it is indispensable to be able to study such reflex

movements, that is to say, the fundamental reactions of the nervous system. Thus, physiologists, more preoccupied, it must be said, with assuring the immobility than the insensibility of the animal, have had recourse to another substance, *curare*, the properties of which were investigated by Claude Bernard.

Curare is a poison which the natives on the banks of the Amazon prepare from a bind-weed of the strychnia family. They boil the plant with several ingredients, finally obtaining a sort of blackish resin, or gummy juice, which they place in little gourds, which can be procured also in Europe. This juice is used by South American Indians for their arrows, and physiologists use it to ensure the immobility of the animal on which they are experimenting. Curare dissolves in water, and a solution of a few centigrams injected under the skin of a dog, a cat, a rabbit, will bring about the death of the animal in a few minutes. But death is not due to the arrest of the heart's action, it is due entirely to paralysis of the respiration. Therefore the curarised animal can continue to live for several hours if *artificial* breathing be substituted for

the natural breathing which is paralysed. For several hours the animal is completely motionless; the heart beats with force and regularity, provided that the insufflation of air into the lungs introduces into the blood the quantity of oxygen necessary for the life of the tissues. Now, under these conditions, as Claude Bernard has so well demonstrated, we have no proof that sensibility is abolished also. There is immobility; there is no true anæsthesia. Take two animals, one chloroformed, the other curarised; both are equally inert; but the chloroformed animal is insensible, whilst the curarised animal retains sensibility.

It is impossible, therefore, to say that curare replaces anæsthetics, because *curare is not an anæsthetic*.[1]

[1] In England, the Vivisection Act expressly states that curare is not to be regarded as an anæsthetic, and this proviso has been loyally accepted by English physiologists. On those rare occasions when curare is used, and the occasions are very rare indeed, and year by year they become rarer, a volatile anæsthetic such as chloroform or A.C.E. (alcohol, chloroform, ether) mixture is administered at the same time in sufficient amount to render anæsthesia absolute. One should add that since Claude Bernard's work on curare, physiologists have seen reason for doubting whether it leaves

Now, in 1894 I was able to discover a substance which has all the anæsthetic properties of chloroform, and which nevertheless does not abolish reflex actions, so that physiologists are able to use it for experiments which, formerly, necessitated the use of curare. This substance is called *chloralose;* it is obtained by mixing anhydrous chloral with glucose. It is not necessary for me to describe here in detail its chemical or physiological properties; I will only say that in very small doses (about twenty-five centigrams) it is an excellent hypnotic for man, and that in larger doses, injected into the vein of a dog or a rabbit, it brings about complete anæsthesia without affecting either the breathing, the heart, or the reflex actions.

Since this discovery, many physiologists—and I regret not to be able to say so of every physiologist—have given up curare and use nothing but chloralose, which is a perfect anæsthetic, and

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sensibility intact, as Bernard thought. But as there is doubt on the question, and the available evidence in favour of its lulling sensations is small, it is still considered advisable to retain Bernard's views, and act as though it is not an anæsthetic at all.—(W. D. H.)

which allows the reflex actions to be studied although anæsthesia is perfect.

It may be objected that a tiny puncture has to be made in the vein to introduce the chloralose into the circulation; but this puncture is really such a trifle that it would be sheer childishness to pay any attention to it. What doctor would hesitate to make a puncture in the skin of his patient for the injection of a solution of morphia? However, if sentimentality be pushed to such a degree as to shrink from touching the vein of a dog in order to put him to sleep, even this tiny puncture can be avoided by mixing the chloralose with the food of the animal to be experimented upon. In half an hour or three-quarters of an hour after the mixture is given he is in a state of perfect anæsthesia.

For these reasons, vivisection with anæsthesia seems to me to be quite legitimate. As soon as it is recognised that man has the right to kill the animal, he has the right to kill him as he pleases, provided he spares him all suffering.

Let us also reflect a little on this point: an animal has to die just as much as we ourselves. Now, natural death would certainly be for him

a long and cruel agony, lasting several hours, several days, perhaps several weeks. Well, then, we replace hideous old age, the agony of prolonged tortures due to disease, by a dreamless sleep, which at once plunges the animal into nothingness, without his passing through the intermediary stage of necessary suffering. Is this what is called being inhuman? For my part, I shall regret on my death-bed that no physiologist will be found whose conscience will permit him, or, if so, who would have sufficient courage to help me to pass away under the influence of chloroform, ether, chloralose, morphia, or chloral, thus saving me from the throes of the final struggle, and bestowing upon me a peaceful death and an easy termination of all suffering.

CHAPTER IV

CONCERNING EXPERIMENTATION OTHER THAN VIVISECTION

We must, however, give to the word "Vivisection" its largest acceptation. It is not only a question of cutting nerves, of stimulating the glands, or of exciting the muscles. There are experiments of much longer duration in which there is no mutilation properly speaking, but *intoxication*,[1] produced by the injection of poisons and disease germs.

It is, indeed, evident that pain can be provoked in other ways than by a sharp-edged instrument, which can always be done under anæsthesia. But may inoculation be performed? May prolonged *intoxication* be caused? To treat the question in all its fulness, we will put the problem in the following manner.

In order to study a disease, have we the right to give that disease to an animal?

[1] See footnote, p. 17.

For my part, there can be no doubt on the point, and I affirm that such is our right.

As a matter of fact, and as every unbiassed person is forced to recognise, it is only by experimentation that these diseases can be studied thoroughly. Clinical observation, bearing exclusively upon man, can only give incomplete results, much poorer, though its documents are multitudinous, than the results furnished by experimentation, which can be infinitely varied at will. If we were limited to the Hippocratic method of observation, which consists in studying the symptoms and the progress of a morbid affliction, we should be reduced to poor enough resources; and if meditation on the aphorisms of Hippocrates constituted the whole extent of our medical science, medical science would be a sad vacuum. Fortunately, however, such is not the case. Marvellous progress has been realised, which allows us to entertain quite other ideas than those of the Father of Medicine on the nature of diseases, and consequently on their treatment and their prevention. Those very persons who rise up in arms against physiological experimentation would not, I imagine,

desire to be handed over to the care of a Hippocratic doctor if they were ill, to a doctor who took no notice of any modern discoveries under the pretext that they were acquired by experimentation *in anima vili.*

If, however, we wish to discuss the problem thoroughly, it will not do to remain on indefinite ground. Let us arrive at precise facts. I will mention only three discoveries, the importance of which is considerable, and which have been established solely by experimentation.

First of all, there is *antisepsis.* For centuries and centuries surgeons operated without understanding why it was that death struck down so unmercifully those operated upon. In vain did surgeons display great skill ; in vain did the operation succeed : the patient died. Erysipelas, lock-jaw, abscess-formation and gangrene reigned supreme. Every confinement exposed the mother to death ; the slightest wounds were followed by the most serious after-effects ; in certain amputations, for instance, the mortality was 70 per cent. No one dared to touch either the peritoneum or the joints, because every operation on the peritoneum or on the articulations was sure to prove

fatal. But Lister and Pasteur came! These two men, simultaneously and concurrently, demonstrated that all disease following on an operation was the result of infection by parasites. By preventing the wounds from being contaminated by parasites, infection was prevented; for the wounds themselves are innocent, as long as they are not infected.

This is the astounding and simple truth which Lister and Pasteur established. And let no one pretend it is so simple that the data could have been furnished by clinical observation alone, for such an assertion would be contradicted by the facts.

Thousands and thousands of surgeons, right up to 1868, had understood nothing of infection. In order to understand this big word "infection," which sums up in itself the whole of surgery and the whole of medicine, it was necessary to inject pus into animals, gather the microbes which then developed in the blood of these animals, isolate the microbes, cultivate them, inject them afresh, and produce an experimental disease. It was in this manner only that we were able to understand the mechanism of antisepsis, and, conse-

quently, apply it to the treatment of operations and wounds. Three or four volumes could be written on this subject alone, but all I can attempt here is a summary of the main points. I say without hesitation that as long as clinical medicine confined itself only to the observation of patients, it was able to understand nothing, to analyse nothing, to foresee nothing. It was necessary to experiment, to sacrifice a few hundred mice, rats, and rabbits, in order to demonstrate that erysipelas is an inoculable disease, that puerperal infection is of the same nature as purulent infection, that all these diseases are due to micro-organisms, and that certain substances, called antiseptics, can stop the development of these fatal germs.

It appears quite natural to-day (and it seems to simple minds, ignorant of the past and powerless to imagine the past, that these notions have been current from all eternity) to know that instruments, water, and linen heated to 120° contain no living germs. But this discovery is not so very old. It was Pasteur who, between 1863 and 1873, established it by some memor-

PASTEUR IN HIS LABORATORY.

facing p. 44.

able experiments at the cost of a little disease given to rats and guinea-pigs.

Now—and I appeal to the good sense of my readers—would it be better to efface the suffering of those rats, those guinea-pigs, those rabbits, and return to the olden times when the mortality in lying-in hospitals was often 40 per cent. (it is to-day, 0.02 per cent.!)? Must we condemn Lister and Pasteur as great criminals because they dared to inoculate microbes into a few rabbits and bring about in those unfortunate animals—they would have died a long time ago even without that—experimental ailments in order to ward off malignant diseases from thousands and thousands of human beings?

The second discovery which I shall mention is that of the infectiousness of tuberculosis. Thousands and thousands of doctors had had tuberculous patients under their care. Three thousand years ago, Hippocrates described tuberculosis with as much precision as could be done to-day. Illustrious physicians in every land had tried to analyse the nature of this terrible disease

and to unravel its cause; nevertheless, they were unable, from clinical observation alone, to prove what is to-day quite commonplace knowledge, viz., that tuberculosis is infectious. In 1864, a French doctor, Villemin, conceived the simple and ingenious idea of inoculating rabbits with the tuberculous matter found in the lungs of consumptive patients. These rabbits became tuberculous; they died in a few weeks with tuberculous granulations in lungs and liver. It was thus demonstrated that tuberculosis was infectious. Later on, in 1878, Koch discovered that the active agent of this infection is a special microbe. But, however important may be the discovery of the microbe of tuberculosis (the tubercle-bacillus of Koch), the essential dominating fact is that tuberculosis is infectious.

As soon as this great fact became known, a profound revolution occurred in social hygiene, in the treatment and in the prevention of this terrible evil. We know now the consumptive man carries in his lungs and sputum the germ capable of developing the same evil in others; consequently we know how to preserve ourselves

against tuberculosis. We must purify or destroy the habitations wherein consumptives have lived, burn or carbolise all the sputum, make spitting in public places a punishable offence, take sanitary measures against unhealthy meat, defend our children against contaminated milk—in a word, we are armed against a disease, the sole and unique cause of which, as experimentation alone has taught us, is infection.

Formerly it was believed that diseases were due to a sort of divine anger, or, what amounts pretty much to the same thing, to certain imperceptible epidemic exhalations stretching over whole populations, or attacking isolated individuals, striking like an exterminating angel, as his fancy chose, such or such an unhappy victim. A sort of will or caprice, governed only by chance, was exercised in relation to this disease, and man was powerless, because he was unarmed against chance. He did not even think of it. He resigned himself to being ill, and waited for the disease, without doing anything to fight against it, benumbed under a kind of Oriental fatalism. The doctor shook his head, bore testimony to the

evil, and confined himself to prescribing inefficacious treatments which were only, according to a celebrated saying, a long meditation on death.

But the times have changed; there is no longer any fatality in tuberculosis; there is imprudence, there is error, there is vice, and, specially, social vice. We may almost say that, if there are still consumptives in our midst, it is because of our defective social institutions. We leave innumerable populations steeped in misery, seven or eight individuals living in the same infected hovel. In the slums of our large cities, swarms of infants are to be found morally and materially perverted by misery. Therefore, if consumption still exists, it is our own fault; it is no longer as it was in olden times, when we knew not, because *now* we know. The plague can be battled with; and if it still has so much power left, it is because we have not the courage to apply to public and individual hygiene the treatment science has definitely shown us should be applied. To foresee is to know; and now that we know, we must not forget that it is to experimenters, and to experi-

menters alone, that we are indebted for this great benefit.

Moreover, however imperfect our defence against tuberculosis may still be, it is by no means *nil;* great progress has been made; the mortality has decreased in a considerable proportion. During the last twenty-five years, it has decreased by about 25 per cent., and notably in England, where the laws of public hygiene, energetically upheld by the good sense of the people, are strictly applied, the mortality has diminished by 50 per cent. This is only a beginning, and the near future will bring about the complete extermination of the disease.

Now, honestly, I ask if the rabbits which Villemin sacrificed weigh more in the scales of universal progress, and even in public morality, than the three millions of individuals who, by progress in hygiene, have been preserved from an early and painful death. I estimate at a high price the life and the sufferings of fifty rabbits, but, at the risk of appearing a barbarian, I prefer, to these fifty rabbits, the three millions of young people who have been

saved by Villemin's discovery, and the millions which it will still save.

All the more so, inasmuch as experimental studies on tuberculosis have not only preserved men; they have also preserved animals. Thanks to Koch, there is now a very simple way of recognising if an animal is or is not tuberculous. Koch was able to extract from tubercle bacilli, a substance which he has called *tuberculin*. At first he thought tuberculin cured the disease; but this was an error. Subsequent experiments showed that tuberculin exercised quite a different action to that of healing. It has the property, when injected in small doses into a tuberculous animal, of provoking an intense fever, whilst it produces no reaction whatsoever in a normal animal. If, therefore, tuberculin is injected into every animal in the cattle shed, we can feel sure—and this is impossible otherwise—that such or such animals are tuberculous or healthy. All cows that show a rise in temperature after an injection of tuberculin are tuberculous; the others, on the contrary, are in good health.

Thus the sanitary inspection of stables and cattle-sheds can be carried out thoroughly ; and we are now able to protect not only men but also animals from the disease of tuberculosis.

Such results could only have been obtained at the cost of many and methodical experiments. Whatever may be the genius of anti-vivisectionists, they would never have been able to imagine anything similar had they been left to their own intellectual powers. It is not in the study that we are able to discover this long series of unforeseen, extraordinary, almost miraculous facts which laboratory experimentation has been able to find out. Man, said Pascal, tires of conceiving sooner than Nature tires of providing ; and experimentation is man's method of interrogating Nature.

The third discovery which I shall take as an example demonstrating the value of experimentation, is the history of *Serotherapy*. And I may be permitted to dwell somewhat on this subject as I had the good fortune, in 1888, of making the decisive experiment which was the beginning of serotherapy.

Whilst inoculating some rabbits and dogs with a microbe taken from pus (*Staphylococcus pyosepticus*), I developed a certain disease both in the rabbits and in the dogs. But the dogs did not die, whilst all the rabbits died from the results of the inoculation. I thought then that, the cause of that resistance being due to the difference of blood, I might be able to make the rabbit refractory to the infection by injecting it with the blood of a dog in normal health. The experiment succeeded. The rabbits which had received the blood of the dog, when they were afterwards infected with the staphylococcus, became very ill but did not die. Later on, I took, not the blood of a dog in normal health, but the blood of a dog that had received the infection of the staphylococcus and had recovered from that infection, and I injected this blood into the rabbits. *Now the rabbits that received the blood of the infected, healed dog had acquired complete immunity to this form of microbe infection:* the principle of serotherapy was discovered (5th Nov. 1888).

Since then, serotherapy has been applied, by Behring in Germany and by Roux in France, to

"L'ENFANT."
In Musée du Luxembourg, Paris.

facing p. 53.

diphtheria (1892). These two savants showed that the blood of animals, and especially of horses, that had been infected with diphtheria and cured, could, when injected into patients attacked by diphtheria, diminish, in an extraordinary proportion, the duration and intensity of the disease. There is no other treatment for diphtheria to-day. A doctor is guilty, and even criminal, if he does not use it, for the therapeutic results of this treatment are marvellous.

I do not speak of clinical observation only. All those who have seen the effects of one of these injections of serum on children down with diphtheria are veritably stupefied at the resurrection which they witness only a few minutes after the injection. The unfortunate child with his purple face and convulsed limbs, scarcely breathing, comes back to fresh life as soon as he has received the beneficent injection of serum. The facts are so decisively clear that even if we have only seen them once we can never again forget them. But I shall simply call the attention of my readers to the following statistics, the result of more than 500,000 observations made in England, in the United States, in France, in

Russia, in Germany, in Italy, in Austria, in fact everywhere: the death-rate in diphtheria before 1892 (for the serotherapic method took four years to become known and practised) was 45 per cent. After 1892, this death-rate fell to 12 per cent.[1] Consequently, out of every hundred patients suffering trom diphtheria, thirty are saved by the serotherapic treatment.

Let us stop for a moment to consider these figures, which seem mere abstractions to those who have not reflected. At the present time, about 300,000 children per annum in France are attacked by diphtheria; that makes 4,500,000 from 1892 to 1907. The proportion of 30 per cent. is therefore 1,350,000. The number of children who have been saved in France alone by serotherapy in fifteen years is therefore 1,350,000. Let us put it in round numbers at one million only; this would be sufficient to justify the death of the twenty-five dogs and the one hundred rabbits which I sacrificed, and of

[1] These statistics can be found in all technical works; and I refer those who may be curious to study them in detail to the special memoirs and excellent treatises on pathology which have been published in England, France, and Germany.

See also appendix.

the two hundred horses which Behring and Roux used for the preparation of the anti-diphtheria serum. A million families in mourning, a million hopes mowed down in the bud! Only fanatics would dare to say this weighs for nought in the balance.

Moreover—and why should I not say it aloud?—this so-called humanity of anti-vivisectionists seems to me the antithesis of humanity. To satisfy a conception which they have forged out of a certain hazy ideal, they make quick shrift of human life and suffering. A hundred weeping mothers, a hundred unfortunate children with gaping throats, suffocating, gasping, the death-rattle at hand—that is what these sensitive souls declare is nothing beside one rabbit which has had to receive a little blood of a dog into its abdomen! These philanthropists are creatures of a fixed idea! Let humanity suffer, weep and die! What does that matter, provided that their fixed idea, driven right up to the hilt of delirium, triumphs! After all, if they persist in believing that the faint and uncertain suffering of a sick rabbit is not worth the certain and excruciating suffering

of a thousand human creatures, I can say but one thing : I pity them from the very bottom of my heart.

These examples — antisepsis, tuberculosis, and serotherapy—will suffice perhaps to justify experimental pathology. There is now another experimental science which I am going to try to justify also. This is *Therapeutics.*

We are only able to learn the action of medicaments by studying the action of poisons, for all medicaments in strong doses are poisonous. Now, to understand a poison thoroughly, we must experiment with it on the animal. Simpson administered chloroform to men only after Flourens had determined its anæsthesic properties on animals. Liebreich, after he discovered chloral, studied its physiological properties on animals, and only after long and learned studies was he able to give it a place in human therapeutics. At the present day, chloral is one of the most extensively used medicines, one which has relieved innumerable patients. When I carried out my research on chloralose, before studying its effects on myself,

I began by giving it to cats and fowls. I was ignorant of the degree of toxic power of this new, still unknown substance, and, at the risk of appearing very pusillanimous, I did not wish to begin on myself; I preferred trying it on a fowl. Not that I estimate my life very highly, but after all, however low an estimate I may place on my own life, I think it is worth more than that of a fowl. Many other medicines have been thus experimented with on animals before it was possible to ascertain their effects on man. Kocher discovered cocaine, Knorr antipyrine; and these two admirable medicines did not find their way into therapeutics until their mode of action and their toxic power had been ascertained on animals.

In a word, the whole of present-day therapeutics has for foundation, not only ancient clinical observation, which it would be supremely foolish to disdain, but also the experiments of modern times, which it would be equally foolish to proscribe.

Perhaps certain people imagine that there are no therapeutics, and that we can replace by auto-suggestion, prayer, or hypnotisation, every-

thing which doctors generally use to cure or allay disease. It is difficult to reply to such objections, because those who make them have never opened a work of science nor seen a patient. They see things as they wish to see them. They imagine that the exterior world is constructed according to their interior vision, and they do not deign to come into contact with reality. They believe that enthusiasm can supply the place of instruction, and that a certain doubtful generosity can replace profound and patient study. They maintain perhaps that chloral does not make one sleep, that salicylate of soda does not alleviate rheumatic pains, that bromide of potassium does not check attacks of epilepsy. Perhaps they will even continue to say so for a long time to come. Let them talk; progress will be made without them.

Les chiens aboient et la caravane passe.

CHAPTER V

SERVICES RENDERED TO SCIENCE AND HUMANITY BY EXPERIMENTAL PHYSIOLOGY

I NOW come to a favourite theme of anti-vivisectionists, viz., that experimental physiology has produced nothing, and that the differences of opinion among *savants* are so considerable that this alone proves the impossibility of vivisection ever establishing anything permanent.

Here again it is difficult to reply because of the very ignorance of the honourable gentlemen who criticise us. Most certainly there still remain many disputed and disputable points in physiology, and nothing is easier than to find therein striking and abundant contradictions. If we wished to amuse ourselves, we might write five or six big volumes on the subject; but let us leave this tedious and useless labour to the anti-vivisectionists to accomplish to their hearts' content. I prefer to tell them, what they do

not wish to know perhaps, that contradiction is the very essence of science. As our demonstrations appeal not to faith but to reason; as we admit free discussion, free investigation from every side; any proposition must have multitudinous and positive proofs in its favour before it can be adopted without hesitation. Even our opinions were never prescribed by faith or violence; we take pleasure in provoking discussion and contradiction. With our adversaries' leave be it said that a dogmatic, irreproachable book, where there was no place for hesitation or doubt, would be the very negation of science. Even the treatises of geometry and mechanics, although non-experimental, rational sciences, sometimes contradict themselves. It has been rightly said that the history of science is the history of human errors—errors which, little by little, draw nearer and nearer to supreme truth without ever attaining it. We must understand this, or we shall be rebelling against the conception of scientific truth.

Now, in treatises on physiology, we find a number of well-demonstrated truths, and a still larger number of truths only half demonstrated,

and, consequently, contested. Our successors will also certainly find in our books of to-day an enormous number of errors.

What conclusion is to be drawn from this fact? Have those who reproach the science of physiology with being only a tissue of contradictions and errors ever opened a book on physiology (for example, the text-book of Schaefer, in two large, compact, closely written volumes of 1000 pages each)? They would there find thousands of positive, incontestable facts on all the questions which concern physiology.

Let us take, each in its turn, the great functions of life, and we shall see that they have become known only by experimentation.

1. *The Circulation of the Blood*, suspected by Michel Servet, Realdo Colombo, and Andreas Cesalpin, was really established by Harvey in 1628.

Yet Harvey was only able to demonstrate it by experiments performed on the living bodies of frogs and deer. Since Harvey's time, the laws of the circulation have been established with admirable precision. Hales demonstrated

the pressure of blood in the vessels. Chauveau and Marey introduced into the heart of a horse an apparatus which enabled the pressure of the blood in the heart, in the arteries, and in the veins, to be measured. Weber found that the pneumogastric nerve stopped the heart's action. Ludwig applied the graphic method to the circulation. Delicate instruments have been constructed which give diagrams of the pulsations and measure the pressure of the blood in the arteries and in the heart of man. Claude Bernard discovered the nerves which regulate the movements of the vessel walls. In short, the whole history of the circulation is due solely to vivisections, and it would be ridiculous to speak of our uncertainties in this respect; for the essential mechanical or nervous laws of the circulation are as well known now as those of the combinations of nitrogen with oxygen.

2. *The Respiration* remained profoundly unknown, as to its inmost nature, right up to Lavoisier's time. Lavoisier placed some guinea-pigs in a box filled with ice, measured the quantity of heat thrown off, the quantity of oxygen consumed, the quantity of carbonic acid

produced; and he was thus able to deduce a fundamental law of life, viz., that life is essentially combustion. He made experiments on himself also; but however great one's respect for the life of a guinea-pig may be, must it be considered wrong that Lavoisier should have experimented on the guinea-pig before experimenting on himself?

As for the laws which regulate this consumption of oxygen and this production of carbonic acid, to discover these it was necessary to put into cages animals of every species and of every size. And there is, perhaps, not a single physiologist who has not made this experiment, at the risk of annoying the cats and dogs thus exposed—without, as far as that goes, doing them any harm—to varied temperatures or to different diets. Moreover, in order to study the respiratory exchanges, physiologists experiment on man as well; is, therefore, the extraordinary scruple against experimenting on animals to be imposed upon them also?

To take an excellent example of the services which experimental physiology can render not

to science only—which would, indeed, be quite sufficient to justify them—but to humanity, I will cite the experiments of Paul Bert with relation to elevated atmospheric pressures. There are certain workmen who are obliged to work under water, at a depth of 20 to 30 yards, for the construction of piers and bridges, or the exploration of sunken vessels. Now, it had long been observed that some of these men died suddenly on returning to the surface. Experimental physiology was able to discover the cause of that sudden death. When a man (or an animal), after having been subjected to several times the normal atmospheric pressure, is suddenly released from this pressure, the nitrogen dissolved in the blood is disengaged suddenly : this produces gaseous embolism, that is to say, bubbles of gas are formed, which block the blood-vessels and prevent the blood circulating in the capillaries. Knowing this, the death of men working at a pressure of four atmospheres could then be avoided by releasing them slowly, that is by bringing them slowly back to the normal atmospheric pressure. Is it barbarous to attach

more importance to the death of these men than to the death of the few dogs and mice that served to establish this law?

I was able to demonstrate that, if the temperature of the air is very high, as in the hottest days of summer, dogs that are muzzled die rapidly of hyperpyrexia (*i.e.* high fever), for they are no longer able to cool themselves by panting. It is true that this experiment cost the lives of a few dogs, but has it not saved many others by pointing out that dogs should not be muzzled under certain conditions? It goes without saying I am not speaking of the theoretical consequences of this experiment.

Artificial respiration, which can restore to life the apparently drowned, is one of the conquests of experimental physiology; for we have been able to determine the best method and the essential conditions (for artificial breathing) by experiments of a very precise nature. Is it nothing to know how to restore to life the apparently drowned?

3. *The Process of Digestion* has also been learned solely by experiment. In the history

of science there are two or three cases of individuals in whom a wound or an operation has produced a gastric fistula, that is to say an abdominal opening through which the stomach can be reached and food introduced. Had we remained satisfied with these accidental observations, we should have obtained but mediocre results. Physiologists therefore have made experimental gastric fistulæ. Dogs thus operated on, after an illness of a few days, recover thoroughly. Some physiologists have kept dogs for several years in this condition: gay, caressing, docile, they did not appear to complain of their lot. They were better nourished, more petted and loved than the many starving dogs which roam about the country. They were not a whit more unhappy than was Alexis St Martin (observed in 1831 by Dr Beaumont) and Marcellin (whom I observed in 1878, at the beginning of my career). Quite recently an eminent Russian physiologist, Pawloff, has, by making gastric fistulæ in animals, been able to discover a number of important facts, absolutely necessary to be known for the treatment of diseases of the

stomach, and even for the establishment of a normal alimentation.

The problem of alimentation is, indeed, one of the most essential, perhaps the most essential, in the history of humanity. I suppose that anti-vivisectionists are aware of the fact that, even in Europe, large populations exist who are insufficiently nourished. Under these conditions, is it not desirable to know exactly the quantities of carbon, nitrogen, salt, lime, and phosphorus which are necessary for animals, and consequently for man? Should not anti-vivisectionists, interested in vegetarianism, before venturing to institute a vegetable diet for man, try it first of all upon carnivorous animals, so as to know how a mixed alimentation can be modified by a vegetable alimentation, and to what extent those modifications are compatible with health?

4. *The Nervous System* is not so well known, so far as its functions are concerned, as the circulatory system or the digestive system. Nevertheless, positive discoveries are extremely numerous: the action of the nerves on the glands and on the muscles; the part played by

the different portions of the brain; nervous degenerations; the laws governing reflex actions —all this constitutes a formidable body of well-established facts. I do not pretend that everything is known. Alas! No! There are still innumerable truths to be discovered, and serious errors are doubtless most learnedly taught, with many contradictions, much uncertainty, much confusion—all of which simply proves that physiology is not a science whose last chapter has yet been written, that the last word of this science has not yet been pronounced. Nevertheless, blind indeed would the man be who would venture to conclude that physiology was not a science; or to assert that physiology is a science of little importance; that the rôle of the physiologist, from the point of view of the alleviation of human miseries, is null; and that knowledge of physiological facts is useless. Will it be claimed that the doctor has no need of a knowledge of physiology? I will reply by a comparison I am accustomed to make before my medical students when I wish to make them understand the necessity of a sound physiological education.

Let us suppose that a watchmaker claimed to be able to cure disordered watches, but at the same time declared himself unable to tell by what springs and by what mysterious mechanism a healthy watch should mark the hour; that watchmaker would inspire me with a very small amount of confidence, and I would not go to him; for, until the contrary is proved to me, I believe that an indispensable condition for repairing a watch when out of order is to know how a watch should work when in good repair.

Physiology exists only because there have been physiologists. By that I do not mean to say that all the truths of physiology are due exclusively to vivisection. I only claim that physiology without vivisection would be strangely clumsy, limited to a few empirical facts, and that, if vivisection be proscribed, we must resolutely give up classing physiology among the sciences. We may study the stars and the earth, electricity and heat, geography and history, and are we to be forbidden to study the functions of living matter? Such a proposal is obviously absurd, for of all the sciences accessible to man, physiology is that which is nearest to him.

It is only the ignorant who dare assert that experimentation on animals cannot be applied to man. There are of course differences which physiologists train themselves to perceive; for example, certain poisons are almost innocuous to some animals, and are very fatal to man. The alkaloid of belladonna, atropine, is a thousand times more toxic for a man than for a goat. It is difficult to kill a goat with morphia, whilst a drop of laudanum kills a new-born babe. Carbonic oxide is absolutely harmless for the invertebrata which have no blood. Crayfish and snails live with impunity in pure oxide of carbon. And I could cite a number of other facts which are described in detail in every treatise of physiology or pharmacology.

But what does it matter to us if we know it? —and we can nearly always know it. There are functional differences between men and animals; and physiologists know these perfectly well by their training; but there are, above all things, much more striking resemblances. It would be, for instance, ridiculous to suppose that oxygen did not dissolve in our blood in about the same way in which it dissolves in the blood of a cat

or a rabbit; that the pneumogastric nerve, which stops the heart of the cat and the rabbit, will not stop the heart of man; that the arterial pressure, which is 16 c.m. of mercury in the horse, the dog, and the cat, is 1 c.m. or 1.60 c.m. in man; that the transformation of albuminous matters into urea takes place differently in the dog and in man. On the contrary, everything goes to prove the general laws are the same, and that the physiology of man, whilst not rigorously identical in every respect with the physiology of the animal, is nevertheless sufficiently analogous to enable a *general physiology* to comprise in its vast laws the functions of every living being, man, mammal, vertebrata, invertebrata, and even every living cell.

CHAPTER VI

MORALITY AND VIVISECTION

If we took the assertions of anti-vivisectionists literally, we should arrive at the strange conclusion, that the victims of vivisection are immensely numerous, and that vivisection is one of the calamities of the century. As a matter of fact, the number of victims due to physiology is very low. Let us try to count them up.

There are only about twenty laboratories in France where experiments on animals are made. Let us allow that there are twenty in England, twenty in Italy, forty in Germany, and fifty in other countries, making a total of 150 laboratories. If we suppose that a dog, a cat, and a rabbit are sacrificed every day in each of these laboratories, we should certainly exaggerate.

Let us suppose, nevertheless, that it is so;

and let us even admit five victims a day, with 300 working days in the year, which is also an evident exaggeration: this will make about 200,000 victims a year. This number, which seems very considerable, is in reality very small, if we put it against the enormous number of living beings. Probably about two thousand millions of mammals die every year, so that the proportion of animals that suffer a little (and very little) through the act of man in his search for knowledge is one in 10,000, in other words, a negligible quantity.

In the immense earthly universe are thousands and thousands of pains, of fierce, incessant struggles between living animals. Every rock in the ocean, every tree in the forest, shelters ferocious combats, and is the constant scene of painful death-agonies. Darwin has admirably shown that life is a struggle for life, that the weak are crushed by the strong, and that the voice of living nature is a cry of distress rather than a hymn of joy. Therefore, in this universal concert of animal pain and of human pain, the slight pain of animals experimented upon is a little thing, and from

an absolute point of view we have the right to disregard it.

Think well over it all for a moment. By giving an experimental disease to a rabbit, for example, I scarcely change its lot. If I had left it to itself, in one, two, or perhaps three years it would have been attacked by another disease, probably more cruel than the tuberculosis with which I infected it. The lot of dogs which die of old age is scarcely enviable. How many poor old dogs have I seen, impotent from rheumatism, completely blind, no longer able to crawl about, covered with disgusting ulcers, seeming to beg for the finishing stroke which would put an end to their misery! And old, worn-out horses! What a spectacle! This residuum of existence of old animals is truly pitiable, and, taking everything into consideration, it is not an enormous dose of happiness we have left them in not sacrificing them when they were young.

But I shall not dwell upon this argument, for it might also be applied to human beings. The Greeks said: "Happy are they who die young, for they are beloved of the gods." Perhaps

some day human ethics will allow us to spare our dear ones the cruel and useless sufferings of old age! I know not. But what I do know is that it is not inhuman to sacrifice an old horse or an old dog in order to save it from going through all the tortures which old age and disease hold in reserve for him.

In any case, the sufferings produced by physiologists who inoculate diseases into animals weigh very little in comparison with natural suffering, not only because the suffering of animals is always more or less immersed in the nihilism of semi-consciousness, but also because these experimental sufferings are less than natural sufferings, and extend over a very small number of victims.

But the question does not lie there. The point is not whether the suffering of animals be a large or small quantity in nature from an absolute standpoint; the question is a higher one: we must ask ourselves if the fact of inflicting pain is compatible with human morality.

Tolstoi says somewhere that the sciences are nothing, that art is nothing, that the true

science is that of good and evil, of justice and injustice. Everything sinks into insignificance in presence of this great duty, or rather life has no other object. We should be entirely engrossed in doing good; justice should be our sole preoccupation.

If, then, from an absolute point of view the suffering of frogs and rabbits does not count, it counts a lot from the point of view of human morality. If a bad child should martyrise a toad, it is not the toad which would interest me: poor creature of diffused consciousness, ignorant even of its own pain, such a tiny pain, too, in comparison with the immense pains which the beings of this great universe are suffering at this moment! No; the toad would scarcely exist for me. The child would interest me greatly; and all my pity would be turned upon that cruel child. My efforts would tend much less towards preventing the toad from suffering than towards preventing that human being from becoming a barbarian.

If the anti-vivisectionists were true moralists and not fanatics they would say: "To provoke suffering to produce disease, to inflict tortures,

is an execrable moral lesson. Whilst the first duty of man is to be good, you instruct young men to be wicked. The doctor, who ought to be compassionate for human suffering, should not serve his apprenticeship in that noble profession by showing himself devoid of pity for the suffering of innocent victims. A civilisation which allows itself to inflict death and torture on living beings can be only a barbarous civilisation."

I recognise the force of that argument. And whilst not a single one of the preceding assertions of the anti-vivisectionists had succeeded in moving me, I confess that this objection of human morality is a most powerful one. I am nevertheless going to try to show that it is not admissible.

And first of all, because there is in this world much suffering, human suffering, which it is more important to allay than that of the victims of vivisection. If our sole care were that of morality, what battles would we not have to fight! There are thousands of people in India who die of hunger; and throughout Asia whole populations perish of disease which a little

hygiene could prevent. The hunger-evil is rife in Russia; most of the peasants in Sicily also never know what it is to satisfy their hunger. The misery of children is lamentable everywhere: in our large cities, Paris, Berlin, London, it is not exceptional, alas! to come across people dying of hunger. The terribly high rate of mortality among children less than a year old is due to hunger and to hunger alone. In Europe two million children, under one year of age, die every year solely because their parents are plunged in misery, because the mother, instead of nursing her child, is forced to work, to earn her living at manual labour, which dries up her milk. *These two million children who die of hunger are the disgrace of our civilisation.* And yet we continue to live in luxury, we look on calmly and indifferently at the agony of our human brothers, an agony which we could easily alleviate. For my part, willingly shall I allow myself to be melted with pity at the sight of tuberculous rabbits when I see those persons who champion these same rabbits, develop within themselves some pity for human suffering, a pity grown so deep, so powerful,

that they devote their entire fortune towards rescuing their brethren from death through hunger.

There is not only famine and want. There are many other social scourges; and these scourges are much more serious than vivisection can ever become. There is alcoholism, prostitution, war. And I have no need to say that alcoholism is an evil, that prostitution is an evil, that war is an evil. When human morality has been developed to such a pitch that man will no longer be able to look on these great social miseries without horror, it will be time enough perhaps to ask if it be permissible to seek for truth at the expense of a little animal suffering. But until then I have the right to stigmatise as hypocrisy all that immense pity which certain people profess for dogs, side by side with their immense heedlessness, which they do not fear to display, towards the fate of so many unfortunate human beings.

If anti-vivisectionists were animated by a great desire for morality, they would endeavour to reform our social condition, which is abominable and full of horrors; they would

strive to impart into youth other notions than that of smug satisfaction with the present social conditions. As long as we have not faced the profound evils which gnaw at the root of our social system, as long as we take a delight in the egotistical satisfaction of our capitalist and martial society, it is not permissible, if we would not be accused of scandalous hypocrisy, to affect pretensions to morality

Even from the very exclusive and rather paltry point of view of animals' rights, are there not among anti-vivisectionists those of social position who make no scruple in amusing themselves by fishing and hunting? In this case they kill, they martyrise, not to conquer new truths, but for their amusement and recreation.

The hunter who fires at a hare sends after the wounded animal a savage dog, trained to fierceness for this pursuit, and he looks on at the chase with delight. The angler who has hooked a fish feels a pleasurable emotion when he holds in the palm of his hand the struggling, writhing being. Elegant sportsmen aim at pigeons to give proofs of their dexterity. A large number of victims do not die on the spot,

but, with wounded wing, or chest pierced with lead, creep away to die in agony in the neighbouring woods. Quite a large gathering of fashionable young women and distinguished young men follow on horseback the tortures of a wretched stag pursued by a furious pack of hounds. And, finally, the entire population of a large city (Seville or Madrid, San Sebastian or Valencia), men and women, old and young, go crazy with delight at the hideous spectacle of a noble bull disembowelling horses, tormented by the picadors, and finally succumbing, exhausted, done to death by his cowardly enemies. There are sights for you! there are amusements for you if you like, which reflect scant honour on human ethics; and well do I understand generous-hearted men and women forming societies to combat war, alcoholism, prostitution, distributing their wealth among the starving populations, also turning their energies against hunting, angling, pigeon-shooting, and bull-fights. It is a noble programme of life which they have drawn up for themselves, and such people merit our highest admiration.

Societies for the prevention of cruelty to

animals are admirable and irreproachable when they defend animals against human savagery: for example, when they prevent carters from lashing into ribbons the skin of the miserable horses under their charge; or when they put down the practice of harnessing a horse to a cart too heavily loaded; or when they interdict cock-fighting and bull-baiting. I will even point out to these same societies, so enamoured of animals' rights, a new kind of protection of quite a special nature.

There exist a number of species of animals which, hunted and hemmed in by man, are on the point of extinction. How many, alas! have for ever disappeared; and no human power will ever be able to bring back to life an animal species once extinct.

It is a great pity; for these charming forms, the joy of the eyes, provided with curious and delicate instincts, have been annihilated for ever. I will give some examples to show to what an extent it is necessary for man to protect the animal against man himself. Man has the taste for devastation; and when he is excited, either by the fury of the hunt or the bait of gain, he does

not hesitate to make many victims without asking himself if these furious ravages will not find their consummation in the destruction of an entire race of animals.

Already in the Polar regions, some fine species of animals have disappeared. The great auk (extinct since 1844) exists no longer. One species of walrus has also disappeared.

The seal is on the road to extinction ; fishermen have indulged in such orgies of destruction that international measures have had to be taken to prevent the total destruction of the species. And indeed be it not forgotten that if the Governments of England and of the United States have made regulations restricting the massacre of seals, it is not by any means in order to stem the tide of destruction of an animal species interesting in itself, but solely because such destruction would put an end to a source of very considerable commercial profit.

A hundred years ago, whales were so abundant that 30,000 fishermen earned their living by whale-hunting. Now, our means of warfare against the cetacea have become so effective

that whales can no longer defend themselves, and their number is decreasing every day to such an extent that we can almost foretell the moment when the whale will have ceased to exist.

In America, vast regions were overrun by immense herds of bisons. They have been massacred with such mad and blind ardour that if the Government had not finally taken some tardy and insufficient measures of precaution, the bison would be extinct too.

Aurochs, elks, chamois, bears have almost disappeared, whereas a century ago they were widely diffused in Europe. In proportion as man takes possession of the earth to cultivate it, he kills off every wild species and replaces them by domestic species where race loses its value. If this goes on, a time will come, unfortunately, when all-powerful man, having given himself up to the thoughtless destruction of everything not of immediate use to him, will have wiped off the face of the earth all save domestic animals. There will be hens, ducks, geese, turkeys, and guinea-fowls, sheep, oxen, donkeys, horses, cows. Perhaps for the pleasure

of hunting, a few deer and a few hares will be preserved; but all wild species which cannot be reproduced in captivity will have disappeared, will no longer be there to delight our gaze. In France, the small birds are destroyed in rank fury, and every measure taken to protect them is inefficacious, thanks to the rage for destruction among the inhabitants. Asia and Africa once upon a time—when almost unknown and unexplored by Europeans—sheltered many a noble animal species to-day well-nigh extinct, and which, if strict measures of precaution be not speedily taken, will soon have disappeared for ever. The large monkeys, the ostrich, the giraffe, and especially the elephant, shun the haunts of man, for man is their ruthless enemy. It looks as though a hundred years hence, not one will be left.

It is not without sadness we think of that future civilisation, a brilliant one perhaps from several points of view, but monotonous and tame, as it will no longer possess this marvellous variety of different animal species which is as one of the smiles of nature. A pitiable uniformity will replace the varied forms which

natural selection has taken thousands of years to bring forth; and then perhaps some tardy poet, in contemplation before the vast sheep-folds and poultry farms, where man will cultivate the species of use to him, will regret those far-off days when birds of all kinds sang in the forests, blending their gambols with those of the graceful animals which human civilisation will have annihilated.

There, I fancy, is a fertile subject for meditation, and interesting initiative for all those who have at heart the rights of animals, and, if I may express myself thus, the future of animality.

But the sight of a vivisection, the preparation of a laboratory experiment cannot be compared with the stupid and mischievous pleasures of angling and hunting. It is not a question of amusing oneself, of killing time, of diversion, of finding in the sight of blood or pain a recreation for boredom. It is quite another motive which animates the *savant.* He has ever before his mind the thought that his efforts are going to bring a little alleviation to the great sum of human suffering. If he inoculates a rabbit with

tuberculosis, he cannot help thinking of all the wretched consumptives who are at that moment in the throes of death. He knows well that each time he discovers even only a particle of truth, that little bit of new truth is going to bring in its train some consequence which will bear fruit in the healing of suffering mankind.

It is with no light-heartedness that the physiologist causes the blood to flow, inoculates disease, injects poisons. I know the thought which animates my friends and my colleagues when they make their experiments: it is never without the most profound pity that we dare to take a healthy, gay, confiding animal, and give him chloroform, or inject a poison into him. This respect for pain, far from decreasing with age, on the contrary goes on increasing. Just as the doctor as he grows older becomes more and more sensitive to the sight of human suffering, so the physiologist who has performed many experiments understands more and more thoroughly the seriousness of pain. He feels all the weight of it: he has a greater responsibility. His morality has become higher and

higher, his sensibility has increased. Often he repeats to himself this line of Virgil's :—

"*Non ignara mali miseris succurrere disco.*"

(Knowing misfortune, I teach the succour of the wretched.)

It would, therefore, be altogether unjust to reproach the experimenter with barbarism or inhumanity; for more than any one else does he possess the sentiment of the immense misfortunes of humanity, and if he resigns himself to experimentation, it is because he sees behind his experiment an alleviation of the sufferings of both man and beast.

It is related that, in one of the great battles of the last century, a general, in order to protect the retreat of his army, was obliged to send a squadron of cavalry to make a hopeless charge upon the enemy's infantry. This meant sending those brave fellows to certain death. Yet he did not hesitate; and with tears in his eyes he gave the order to charge, convinced, as every general should be, that it is sometimes necessary to sacrifice a few human lives for the salvation of the army, for the salvation of the country.

Well, then! We consider ourselves as soldiers waging battle against the blind, malefic forces of nature. On certain days, so as to triumph over disease and ignorance, we must sacrifice a few victims. Then we do not hesitate, and it is our duty not to hesitate.

It even seems to me that those men who pass their lives in nauseous rooms, amidst poison and virus, receiving no other recompense for long labours than the satisfaction of duty accomplished, merit the esteem and respect of every one. They seek neither wealth nor honours. It is not in the laboratories of physiology that a man grows rich. It is not in the laboratories of physiology that man wins high social positions. But what matter! He has used his life to alleviate the sufferings of others. He has had ever before him another ideal than that of the anti-vivisectionists, the ideal of human suffering, which is much more to be respected than animal suffering in spite of all empty words and phrases.

Therefore, when we speak of vivisection or of experimentation before young men, we must not be taxed with immorality; because work,

the search for truth, pity for the misfortunes of man, pity also for the unfortunate animals—these I think are subjects which should ennoble the minds of the young men who listen to us.

CHAPTER VII

ARE LAWS REGULATING VIVISECTION NECESSARY?

We will now briefly consider an interesting and highly practical side of the question. In certain countries, as in England, there are laws regulatting vivisection. In other countries, as in France, Germany, and Italy, there is nothing analogous; consequently public opinion on this point is uncertain.

In the beginning of this book, I acknowledged that, in spite of the exaggeration of their complaints, anti-vivisectionists had rendered real service to general morality by calling attention to the excesses committed by a few vivisectionists in the past. No one recognises this benefit more than I, and I willingly grant that their preaching has, on the whole, had a happy result. Is it however, expedient to go further, and to prohibit or simply to regulate vivisection?

For reasons given above, it seems to me that prohibition would be absurd and injurious, as well in the land of Harvey and Hunter as in the lands of Bernard and Pasteur, of Galvani and Spallanzani, of Johannes Müller and Helmholtz. Prohibition would mean closing the book of science, stemming all progress, condemning humanity eternally to the same miseries, to writhe, powerless, in the same old track. Fortunately, no one thinks seriously of suppressing physiological experimentation ; and, therefore, we have no need to dwell on this point.

But regulation is quite a different thing from prohibition. Now, I showed that certain practices should be condemned. Should they, however, be condemned by law? Why should the law be substituted for the exigencies of science? Here is a physiologist, fully conscious of the magnitude of his task, to whom the government or a university has confided the direction of a laboratory, who finds himself face to face with a problem needing to be solved. It is impossible to limit his efforts and to lay down principles from which he could

not turn aside. Just as he is referred to for the purchase of his instruments and the nomination of his staff, so must he be left full latitude in the arrangement of his experiments. Nothing is so pernicious in matters of science as official regulation ; it takes away all initiative, and does not allow the genius of the inventor to have full play.

As a matter of fact, even in England, the only country where up to the present the conditions of vivisection have been regulated by law, no one has ventured to confine the initiative of the experimenter within narrow regulations. And it is fortunate that no one has ventured to define the limits of experimental investigation, for most excellent work is due to contemporary English Physiologists — Schäfer, Horsley, Sherrington, Langley, Bayliss, Starling, Stirling, etc. They have been able to pursue their researches freely, to the very great advantage of our science.

One should not, then, think of prohibiting such or such a proceeding in vivisection. It may even be dangerous to absolutely prohibit vivisections without anæsthesia. I make no

mystery of my opinion on this point, since I have distinctly declared further back that no sensitive animal should ever be operated upon. I regard as a moral error all vivisection made on an animal capable of suffering. But I would leave the physiologist to be the judge in the matter. I do not believe the law should take his place; for perhaps cases will occur where anæsthesia is impossible, and he cannot be placed under the hard alternative of not making an experiment which his conscience as a *savant* judges to be useful, or of disobeying the law.

Moreover, how are the many possible conditions of an experiment to be precisely laid down? Is the law to indicate the kind of anæsthetic to be used, and the degree of anæsthesia to be attained? Is it to prohibit all experiments on toxic actions? Many insoluble difficulties would be encountered, the sole result of which would be to paralyse the *savant* in his researches or to cause him to break the laws of his country.

And yet I recognise that regulation is indispensable, but it ought not to bear on the nature

of the experiment; it should deal solely with the person experimenting.

I believe the right of practising vivisection should not be accorded to every citizen, to every medical student; it should not be permissible for any chance person to take a dog, to fasten him down on the operating table, and to experiment on the brain, the glands, the muscles of that unfortunate animal, for that chance person is, in all probability, a clumsy and ignorant man. Vivisection may not be undertaken in a light-hearted fashion. After all, science would lose nothing if such an experiment were not made, and I see no advantage in encouraging attempts of this sort which are condemned beforehand to be fruitless.

But in a laboratory of physiology, under the direction of the professor and his assistants, under their moral responsibility, vivisection should not be prohibited; the number of vivisections should not be limited, and no restrictions ought to be imposed.

As I have no intention of formulating or drawing up regulations or enacting laws, I shall not indicate the penalties to which those

who violate the law should be liable. I shall content myself with enunciating this double principle: entire liberty in vivisection for professors of physiology and their assistants; prohibition of vivisection for all others.

CHAPTER VIII

VIVISECTION AND THE FUTURE OF SCIENCE

Let us now leave the opinions of anti-vivisectionists, and carry the problem on to higher ground. Let us see what are the rights of man in Nature, and what is the purpose of human life.

Amidst all the unsettled and contradictory theories accumulated by philosophers, thinkers and founders of religion, there remains scarcely any fixed and immutable theory save that of one dominating principle: The respect and love of our brothers in humanity. All else is contestable and contested. Though we are unable to demonstrate it formally, there is one universal moral law (the great Categorical Imperative of Kant) which commands us to be just and beneficent to our fellow-creatures. All the most subtle sophisms will never be able to persuade me that I ought not, above all things,

to feel solicitude for the lives and happiness of men.

I willingly admit that beside man there is the animal, *our inferior brother* as it has been ingeniously called, so that we have also our duties towards these inferior brothers. But *this must never be to the detriment of our real brothers.* It seems to me insane to consider the life of a cat of more account than that of a man; the pain of a dog than that of a child. All the more so because living matter, if I may use that expression, possesses varying degrees of perfection; from the sea-weed up to man there are successive stages of living forms which constitute an uninterrupted chain ending in its final phase, which is man.

Man, by his power of thought, and consequently of suffering, by the conception which he is able to make of the non-self, by his faculties of abstraction and the notion of good and evil, is vastly superior to every other living being. So that, for respecting, defending and loving men, I have not only the reason that man is my brother, but also that this brother is superior to every other living thing.

That is why a moral code must be essentially human, having for its highest object the happiness of other men. Every other code of morals, having in view a different purpose supporting itself on metaphysical lucubrations or haunted by puerile anxieties, such as the adoration of beasts, appears to me to bear the stamp of fetishism. An unknown power has caused us to be born; we are entirely ignorant of our destinies, we know not why we were born, why we die, why, following in the wake of countless generations, we transmit the vital spark to countless succeeding generations. We know nothing of all that; but it matters little from the point of view of our duty. Duty is independent of all theory. No mere religion is necessary to constitute a moral code.

Homo sum, humani nihil a me alienum puto, or rather our moral code, will be the religion of humanity. It does not seem to me possible to conceive of any other.

And when we say humanity, we take that word in its largest acceptation. It is not a question of compatriots, nor of Europeans, nor even of humanity of to-day. It is also a question of the

humanity of the future. We have our duties towards the man of to-day; but we have also our duties towards the man who will live in the centuries to come. We should prepare the way for a happier and better humanity. Our task is not limited to the present hour; it extends to all those human beings who will come after us. Inasmuch as we of to-day, at every moment of our lives, benefit from the accumulated services of our ancestors, so the men to come will profit by the benefits which we are endeavouring to prepare for them.

Assuredly, Humanity will not be eternal, and Science seems to prove that a time will come when the sun's heat will be insufficient to develop life on the surface of our puny planet. A time will come when the earth will have cooled down and become like our pale satellite, the moon, a dead star, where the debris of extinct multitudinous civilisations will disappear under the ice. But what matter! We have not to trouble ourselves about those far-off times. We have to think of the man of the coming centuries, and, at the same time, it goes without saying, of the man of to-day.

To lessen their misery, to make their existence less lamentable, to develop within them the sentiments of justice and brotherhood, to secure their moral welfare and their material welfare, that is our strict and sole duty. I recognise no other.

Now, there is but one way open to attain this noble goal: Science. We are plunged in an ocean of gloom. All is dark, unknown, disturbing. We have not yet understood anything of the blind forces surrounding us on all sides. We are but feeble beings cast into the midst of sovereign powers which overwhelm and bear us down. Now, to avoid being completely and definitely crushed out of existence, it is necessary to penetrate into the nature of these forces. Alas! we shall never penetrate into them, for it is madness to think that a particle of the whole can ever fully cognise the whole; but we may at least demonstrate some facts, fathom some phenomena, perhaps trace a few of the features of certain laws. That is enough to make us instantly the masters of matter and not its slaves.

Every new truth at once brings about an

amelioration in human conditions. It may be said that our *happiness is made up of truth.* Let us suppose what is improbable, that is to say, that we have come to know all the laws of Nature, should we not immediately become all-powerful? Should we not be the sovereign masters of disease and pain, perhaps of old age and death?

Such, indeed, appears to be the conviction of the human societies which assign a preponderating role to Science. They have understood that there is no better future in store for the human being than that which Science will bring about for him.

To be able to appreciate the extent to which the man of to-day is materially and morally happier than the man of past ages, we have only to compare the present state of our civilisation with the state of past civilisations. We may say that an English labourer of to-day has a much easier existence than had an Italian prince of the fourteenth century. Everywhere, the progress achieved by Science has entered into the life of each individual. We find it in the book we read, in the electricity which gives

us light, in the train or the steamer which carries us to the uttermost corners of the earth in little time and at little cost. It is the same thing also with medicaments, which are certainly able to lessen the pain of disease.

Moral progress has kept pace with material progress. At the same time that matter has been overcome, our customs have become gentler; individual liberty is a sacred thing; each citizen takes part in the decisions of his government; there is no longer either slavery or torture or tyranny of conscience. In a word, the man of to-day is happier and more powerful than the man of bygone days.

This happiness has not been acquired through any providential "miracles." No God came down from His Heaven to alleviate human misfortunes. It is man, and man alone, who, by his genius and his labours, has been able to make himself master of the forces which, even yesterday, held him in bondage. And we cannot be too grateful to our fathers for their immense and fruitful labours, by which they succeeded in constructing the society in the midst of which we live. It is still wretched enough, this society

of ours, afflicted with crimes and horrors, the infamy of which we understand full well; but however wretched it may be, it is a thousand times less wretched than was society of yore.

Therefore, this formal conclusion may at once be deduced; we must do for our descendants what our fathers did for us. We would be without excuse if we rested content to benefit from the works of our predecessors without ourselves also creating something, without leaving, by means of our personal labours, a better lot to our descendants. The man who has not understood this supreme duty is truly unworthy of being a man.

Verily, every individual, when he has arrived at the end of his life, should examine his conscience and ask himself if in the humble sphere of his action, he has not, even he also, contributed a stone to the human edifice, if he has not done his share in promoting and increasing the forces of humanity.

Since matters stand thus, since the development of Science is the fundamental condition of the happiness of man, we must resolutely put Science at the basis of every civilisation. Alas!

it has not been so up to the present; and if we study the development of human societies, we see that they are above all things attracted to war. Science has had only the leavings. But the time has come when man should no longer believe that the principle of morality is man's struggle against man. That was the history of bye-gone times. The history of to-day, and especially the history of to-morrow, is the struggle of man against matter, the subjection of natural forces to our intelligence. And there is no other way to subjugate these forces than by learning to know them.

Then Science will be put in the foreground. And without making any classification which distinguishes between the sciences, which are all useful, beautiful, and noble, for all contain a portion of truth, we shall be permitted to say that the Science of life is one of the most useful, the most noble, and the most beautiful.

Now, the Science of life is Physiology, taking physiology in its widest sense, that is to say, the study of normal beings and of diseased beings. It is proved by innumerable facts, facts which only bad faith and ignorance can call into

question, that our physiological knowledge is due, in a very large measure, to experimentation. If in thought we suppressed the scientific results which experimentation has conquered, we should have but an inferior science, within the reach of the Brahmans may be, but unworthy of our present scientific standing. We should know nothing of the circulation of the blood, nor the function of the blood corpuscles, nor the formation of sugar, nor the innervation of the glands, nor the contagiousness of disease, nor the power of poisons; we should be reduced to the notions of Hippocrates, we should be less advanced than Galileo, the first ingenious experimenter who indicated, less by his writings than by his experiments, that the basis of physiology, and consequently of the whole of pathology, is experimentation on animals.

Those most sincere persons who wish to banish experimentation from Science are consequently, I do not fear to say it, standing in the position of direct contradiction to true morality. To refuse man the right to study living nature, is as though we declared that living nature ought not to be known. Alas!

anti-vivisectionists will not listen. In vain do we tell them that we, physiologists, preserve man from disease; that we have alleviated the ills of our human brothers. They stop up their ears; they shut their eyes; they have no pity for the sufferings of human beings. It seems as though the tears of their brethren were profoundly indifferent to them. Is this a high morality? Is this a realisation of their duty as men? They cover with opprobrium the names of Harvey and Jenner, Bernard and Pasteur, Spallanzani and Helmholtz. What base ingratitude! It is these great men who have turned aside many excruciating sufferings from humanity; it is these grand men who have bestowed a better lot on so many human beings. When, therefore, they dare to calumniate the masters who have scattered over us so much beneficence, anti-vivisectionists seem to me to be not only the most ungrateful but even the cruellest of men.

Fortunately the conquering march of Science will not be hindered. We shall never return to those sinister times when our great Vesalius had to forfeit his life for having dared to

dissect a human corpse. We shall continue to make Science advance towards its great aim, the good of man.

And this is the moment which has been chosen for striving to arrest the march of Science: when epidemic disease, such as the plague and cholera, is checked; tuberculosis half-conquered; diptheria rendered inoffensive; operations become almost harmless; cancer on the eve of being understood and subjugated! And are we to stop there? Are we not to seek to fathom the many problems still waiting to be solved, and on which depend the lives of so many human beings, and so much human happiness? Do you believe that Science has come to an end? Certainly we already know a great deal; but what we know is as nothing compared to what we do not know.

An immense domain of unknown truths lies open to our activity. And we are able to forsee what inexpressible benefits these new truths will scatter over suffering humanity. Consequently, everyone, every man enamoured of goodness and justice, should be filled with respect for Science, and set all his hopes on her.

At the same time, however great may be my adoration for Science, it must not be at the expense of human personalities, or, let us say it distinctly, at the expense of animal personalities, which although uncertain and indistinct, still merit a share, and a large share, of justice and of pity.

As for human personalities, without the slightest doubt, we have not the right to sacrifice an innocent creature for Science. Every human being ought to be treated with respect, and we have not the right to kill and martyrise a human being even if his death and his martyrdom might serve the cause of Science.

As for animal personalities, the question becomes much more doubtful. For inferior beings with indistinct consciousness, and, without a doubt powerless to perceive pain, no scruple should hold us back. But if it concerns beings nearer to ourselves, such as monkeys, cats, dogs, horses, all certainly capable of feeling pain, we must be chary of inflicting pain, and experiment only after having totally abolished in them all sensation of pain. But under penalty of falling

into fetishism, we must not fear to use the life of these beings in order to prolong the life of man. Every time we propose to make an experiment, it is as though we put this question to ourselves : is this dog worth more than a man ? or than a hundred men ? or than the whole of humanity to come ? Thus put, the problem bears only one solution : Avoid giving pain to the animal on condition that it is not at the cost of innumerable human pains. Moreover, it is the same here as in every question we may wish to investigate : Each of the two adversaries set out from a just principle, incontestably just. But each one pushes the just principle so far that he ends by transforming it into a colossal absurdity.

In the present case, the anti-vivisectionists say : pain is an evil, even the obscure pain of the lowest animal is an evil. Now, we should do no evil ; therefore we should not at any price inflict any pain whatsoever, however light it may be, on even the lowest animal. That is their syllogism. It cannot be replied to, for it is perfectly correct.

We on our side say : The suffering of man

is a sacred thing. Science casts aside suffering from man. Therefore we ought to sacrifice inferior beings to the cause of Science, that is to say to the happiness of man. There again lies an irreproachable syllogism.

But these two syllogisms, if driven up to their ultimate conclusions, would lead to nonsense on the one hand and cruelty on the other. If we were to listen only to the friends of animals, we should not have the right to bleed a horse in order to save the lives of 400 children; and this contention would be both foolish and cruel.

If we were to listen only to the friends of man, we should have the right, simply as dictated by our might and fancy, to cause suffering to dogs, cats, monkeys, all innocent and sensitive animals, under pretext that these tortures are capable of alleviating human pain. That also would be folly and cruelty.

Fortunately, wisdom avoids both extremes; it fears the brutality of hard and fast syllogisms, which are absurd even by their very severity. Yes, there are the rights of man; yes, there are the rights of animals; and all our efforts should

consist in holding an even balance between these two sometimes antagonistic rights. Do not let us push our reasonings to their logical but absurd extremes. Pre-occupation for the welfare of future humanity and of Science does not authorise us to be wicked and unjust towards the men of to-day, even towards one single man. So that, notwithstanding my worship of Science, I would not sacrifice human lives to her. And, notwithstanding all my respect for animal pain, I would look upon the man as supremely ridiculous, even guilty, who would not innoculate a microbe into a rabbit to achieve a great discovery for humanity. Wisdom, therefore, consists precisely in this : to know where to stop in pushing a reasoning to extremes. This is what physiologists have sought and are seeking to do.

In any case, and as a last conclusion, Science ought not to be sacrificed. Now, the death-knell of science will have sounded when *savants* are prevented from pursuing their investigations on living beings. We who, in full confidence, hope for a happier and better humanity, will never resign ourselves to closing our laboratories, to burning our books. On the contrary, we are

determined, every one of us, to continue our hard labours for the great good of the men of to-day and of the generations to come.

And when we speak of Science, we do not mean only the material benefits she scatters abroad; we think also of her power as a moral force. Material and moral conquests walk hand in hand. Science is the basis of the moral law. The universal consciousness of humanity grows greater by the acquisition of new truths. Each individual, by the very fact that he loves truth, has come to understand the moral ideal which should be ever before his eyes.

And then, in a just measure, full of pity for all suffering, but placing the suffering of man at a higher price than the suffering of the animal, we shall strive to make the respect of animal suffering accord with the search for the splendid and indispensable and divine TRUTH.

POST SCRIPTUM

In the various works, notices, discourses, etc., which have been published upon Vivisection, generally against Vivisection, I find various erroneous assertions which it is important should be pointed out. I will do so briefly.

There is, however, one assertion which appears fairly just to me. This is that in treatises on physiology, sufficient mention is not made of Vivisection, of its limits and of its abuses. At the beginning of a treatise on physiology, the author should distinctly declare there is always cruelty in vivisection conducted without chloroform or chloralose; the author should indicate that these anæsthetics ought to be administered under such or such conditions. Before initiating medical students into the study of life, it is also well to teach them to have respect for animal suffering. I would that it might be thoroughly understood that it is a matter of absolute necessity to operate upon the animal; and that when

the physiologist resigns himself to this necessity he ought to perform the operation with sufficient humanity to prevent the animal from suffering. I willingly recognise that the absence of this first moral precept is a great gap in most treatises on physiology.

This, however, is about all I can concede to anti-vivisectionists; for truly they indulge in such queer, extraordinary assertions that we are completely disconcerted. Some of these fanatics pretend, for example, that physiologists should practise vivisection upon themselves. To torture a dog is as criminal as to torture a child, according to them; and animal suffering is as much to be respected as human suffering! Truly such a paradox cannot be taken seriously; if it were admitted, evidently the question is settled. But it cannot be admitted, and the whole of our argument rests upon this principle, which appears quite evident, that living beings occupy different positions in the hierarchy of nature.

Let us take a besieged city reduced to famine: will anyone pretend that the soldiers must be sacrificed before the horses, the mules, etc. Yet the case is exactly the same. It is in order to

avoid the death of human beings that mice and guinea-pigs are put to death.

To deny the difference in rank of living beings is to deny evidence. A frog is a nobler animal than a sea-urchin; a dog is a nobler animal than a frog; for there are degrees in the intelligence, and consequently, in the capacity to suffer, and in the *quality* of suffering among the four animal groups: the sea-urchin, the frog, the dog, and man.

Anti-vivisectionists do not admit reflex movements (which, moreover, they do not understand); and they bewail the dogs that Goltz and Ewald subjected to cerebral mutilations which took away all intellectual spontaneity and prevented them from eating spontaneously. But in those very dogs, precisely because there is no spontaneity, so there is no longer any consciousness of pain. They are, therefore, of all the beings in creation those which deserve the least commiseration; for they are protected against pain by that very ablation of the brain, the seat of pain.

We are told that it is through cowardice, through the fear of disease, that vivisection is

practised. But fear of disease is not cowardice. I am neither poltroon nor coward, but I would be very sorry to be attacked by tuberculosis or cancer. I do not blush to confess that it would be very disagreeable for me to be hanged, though hanging is much less painful than tuberculosis or cancer. If it were necessary to have a hanged victim, I would much prefer that a rabbit were taken in preference to myself; and I would certainly not put my own neck in the cord to save a dog from torture.

The state of mind of anti-vivisectionists appears to me rather singular, since they are not at all afraid of disease as far as man is concerned, but they have great fear of it for animals. If pain is but an empty word, according to the celebrated phrase of Zeno, why not apply that fine maxim to the animal?

Sir James Thornton (*The Principal Claims on behalf of Vivisection*, London, 1907), has endeavoured to compile a list of the contradictions to be found in the treatises of physiology. He could have added considerably to the length of this chapter, for the contradictions are innumerable; which only proves, not that

vivisection is useless, but that it is difficult. What would chemists say if it were maintained that chemical analysis was absurd because of the contradictions between chemists? They would, and rightly so, continue to make analyses; for they know that analysis is a necessary, though an imperfect, instrument. In the same manner, we shall continue to practise vivisection, though we know right well that vivisection is an imperfect, though a necessary, instrument.

In the course of a recent debate on vivisection, a voice was heard to call out that Lister was a brute. That "crowns" everything, and one would think that nothing more inept could be imagined.

Alas! something more inept still has been said, and I hand over this prodigious and audacious assertion to the judgment of every man of heart and common sense. It refers to bacteriology. The author, after having said that microbes are not the cause of disease, takes refuge behind the opinion of Lawson Tait (quoted by Mona Caird, *The Inquisition of Science*, p. 20).

"Such experiments never have succeeded, never can: and they have, as in the cases of Koch, Pasteur, and Lister, not only hindered true progress, but they have covered our profession with ridicule."

That is something which may well confound us, is it not? and I believe those great benefactors of humanity, Koch, Pasteur and Lister, may indeed murmur: "Forgive them; for they know not what they say."

To sum up: the objections of anti-vivisectionists are irrefutable if we admit, (1) that man has not the right to kill an animal either in self-defence or for nourishment; (2) that the suffering of an animal is as worthy of respect as the suffering of a man; and (3) that the misery of one individual is as sacred as the misery of a thousand individuals. No logical reply can be made to these three assertions, which, according to my reasoning, constitute an offence against the most elementary common sense. But I doubt very much if we shall ever arrive at demonstrating that it is better to allow one hundred children to die from diphtheria rather than draw a little blood from a horse; or that

we should practise vivisection on man so as to alleviate the diseases of dogs.

Concerning the polemics of anti-vivisectionists as to the uselessness of physiology, and the contradictions of physiologists, they are nothing but a tissue of error and ignorance.

APPENDIX A

We give herewith a table showing the absolute and relative mortality due to diphtheria in Paris from 1872 to 1905, out of a population of 2,500,000 inhabitants :—

	Absolute.	Per 100,000 Inhabitants.
1872 . .	1135	61
1873 . .	1164	62
1874 . .	1008	52
1875 . .	1328	68
1876 . .	1572	79
1877 . .	2393	117
1878 . .	1995	95
1879 . .	1783	83
1880 . .	2048	94
1881 . .	2211	99
1882 . .	2244	100
1883 . .	1781	79
1884 . .	1928	86
1885 . .	1655	74
1886 . .	1512	67
1887 . .	1585	70
1888 . .	1729	74
1889 . .	1706	72
1890 . .	1668	70
1891 . .	1361	56
1892 . .	1403	58

	Absolute.	Per 100,000 Idnabitants.
1893 . .	1266	52
1894 . .	1009	41
1895 . .	435	17
1896 . .	444	17
1897 . .	298	12
1898 . .	259	10
1899 . .	339	13
1900 . .	294	11
1901 . .	736	28
1902 . .	709	26
1903 . .	399	15
1904 . .	260	10
1905 . .	204	7

Let us divide this mortality due to diphtheria into three groups (in Paris per 100,000 inhabitants):—

A. Before the discovery of serotherapy, from 1872 to 1888.
B. During the period of experimentation with serotherapy, from 1889 to 1894.
C. After the generalisation of serotherapy, from 1895 to 1905.

We have then the following averages:—

	Absolute.	Per 100,000 Inhabitants.
Before serotherapy . . .	1657	80
Intermediary period . . .	1402	58
After serotherapy . . .	398	15

And should these figures not seem sufficiently eloquent, let us set them forth in another form:—

	Absolute Mortality.
Before the discovery of serotherapy, 1888 .	1729
1st year of serotherapy, 1889 . . .	1706
2nd „ „ 1890 . . .	1668
3rd „ „ 1891 . . .	1361
4th „ „ 1892 . . .	1463
5th „ „ 1893 . . .	1266
6th „ „ 1894 . . .	1009

At this moment the practice of serotherapy, thanks to Roux, became general in Paris.

1st year, 1895—435.
2nd „ 1896—444.

During the next six years there were still hesitations and uncertainties as to the best method to be employed.

The mortality during these six years, 1897-1902—439.

Then the practice was definitely established.

The mortality for the three years, 1903-1905—288.

These figures are so eloquent, so striking, so precise, that it is not possible to misunderstand them. They cannot be ignored; and when once they have been set forth, ignorance is no longer permissible, and it is for that reason we have here given them.

In Berlin and in Vienna, it is the same thing. From 1894 the mortality due to diphtheria has diminished to the extent of 150 per cent.

APPENDIX B

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APPENDIX C

THE RESEARCH DEFENCE SOCIETY

In January 1908, a Society with the above name was formed in England, the aims and objects of which are clearly stated in the following letter from Lord Cromer, its President; this letter was published in the English newspapers on 24th April 1908:—

Sir,

A Society has been formed, with the name of the Research Defence Society, to make known the facts as to experiments on animals in this country; the immense importance to the welfare of mankind of such experiments; and the great saving of human life and health directly attributable to them.

The great advance that has been made during the last quarter of a century in our knowledge of the functions of the body, and of the causes of disease, would have been impossible without a combination of experiment and observation.

The use of antiseptics, and the modern treatment of

wounds, is the direct outcome of the experiments of Pasteur and Lister. Pasteur's discovery of the microbial cause of puerperal fever has in itself enormously reduced the deaths of women in child-birth.

The nature of tuberculosis is now known, and its incidence has materially diminished.

We owe the invention of diphtheria antitoxin entirely to experiments on animals.

The causes of plague, cholera, typhoid, Mediterranean fever, and sleeping sickness, have been discovered solely by the experimental method.

Not only have a large number of drugs been placed at our disposal, but accurate knowledge has replaced the empirical use of many of those previously known.

The evidence before the Royal Commission has shown that these experiments are conducted with proper care; the small amount of pain or discomfort inflicted is insignificant compared with the great gain to knowledge and the direct advantage to humanity.

While acknowledging in general the utility of the experimental method, efforts have been made by a section of the public to throw discredit on all experiments involving the use of animals. The Research Defence Society will therefore endeavour to make it clear that medical and other scientific men who employ these methods are not less humane than the rest of their countrymen, who daily, though perhaps unconsciously, profit by them.

The Society proposes to give information to all enquirers, to publish *précis*, articles, and leaflets, to make arrangements for lectures, to send speakers, if required, to debates, and to assist all who desire to examine the arguments on behalf of experiments on animals. It hopes to establish branches in our chief cities, and thus to be in touch with

all parts of the kingdom; and to be at the service of municipal bodies, hospitals, and other public institutions.

The Society was formed on 27th January of the present year, and already numbers more than 800 members.[1] It is not an association of men of science or of medical men alone; its membership has been drawn from all departments of public life, and includes representatives of every class of educated Englishmen and Englishwomen, including many who have taken an active part in the prevention of cruelty to animals. This fact is in itself a remarkable protest against the attacks which have been made on the researches that the Society has been formed to defend.

The annual subscription is five shillings to cover working expenses: but larger subscriptions, or donations, will be gladly received. The acting Hon. Treasurer, *pro tem.*, is Mr J. Luard Pattisson, C.B. (of the Lister Institute),[2] and an account in the Society's name has been opened with Messrs Coutts & Co., 440 Strand. The Hon. Secretary is Mr Stephen Paget, 70 Harley Street, W., to whom all communications should be addressed.

Yours faithfully,

CROMER, *President.*

The following is a list of the pamphlets already issued by the Society:—

1. Letter from the President announcing the formation of the Society, April 24.

2. Report of the inaugural meeting.

3. Experiments on animals during 1907 in Great Britain and Ireland.

[1] 22nd October 1908. The number of members is now over 1530, of whom 160 are ladies.

[2] 27th May. Dr Sandwith, 31 Cavendish Square, London, W., is now Hon. Treasurer.

4. Some facts as to the administration of the Act.
5. The value of antitoxin in the treatment of diphtheria.
6. Evidence of Sir Frederick Treves.
7. Yellow fever and malaria.
8. Extinction of Malta fever.
9. Have experiments on animals advanced Therapeutics?
10. The work of the Research Defence Society.
11. Vivisection and medicine. Evidence of Lord Justice Fletcher Moulton before the Royal Commission.

All or any of these will be forwarded on application to the Hon. Secretary, Mr Stephen Paget, 70 Harley Street, London, W. Other pamphlets are in active preparation; arrangements are also being made for meetings, and for the organisation of Branch Societies in many parts of the kingdom; the Society is also concerned in the institution of a similar movement for the defence of research in America.

Space does not permit the publication of the full list of members of the Society. The following list of the President and Vice-Presidents, however, will show that those who have joined are representative not only of the leading men and women in the medical profession, but also of those who are pre-eminent in various other branches of science, in literature, politics, art, and theology.

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The Rev. H. G. Woods, D.D. (*Master of the Temple*).

* Since deceased.

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